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TITLE: UH - USA Agreement - A Telemedicine Research Proposal

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The purpose of the University of Hawaii Telemedicine Curriculum Research Project is to develop an effective web-based curriculum for training military healthcare personnel in the use of contemporary communication, automation, and informatics technology in the delivery of healthcare. The overall curriculum is generic in nature, while specific modules can be tailored to the needs of the military healthcare provider (HPC). The goal of the telemedicine curriculum is to impart both the necessary knowledge and practice skills to the HPC. The HPC will learn the various clinical uses of telemedicine and will also understand the clinical and organizational barriers of the successful utilization of telemedicine. The telemedicine curriculum has been designed to address the communication and automation tools available to the military healthcare system. This advanced toolkit of telemedicine curriculum modules will support the efforts of the DoD to efficiently and effectively apply the latest technological advances in communication and data transfer to improving healthcare delivery.

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INTRODUCTION

The purpose of the University of Hawaii Telemedicine Curriculum Research Project is to develop an effective web-based curriculum for training military healthcare personnel in the use of contemporary communication, automation, and informatics technology in the delivery of healthcare. The overall curriculum is broad in nature, whereby specific modules can be tailored to the needs of the military healthcare provider (HPC). The goal of the telemedicine curriculum is to impart both the necessary knowledge and practice skills to the HPC. The HPC will learn the various clinical uses of telemedicine and will also understand the clinical and organizational barriers to the successful utilization of telemedicine. The telemedicine curriculum has been designed to address the communication and automation tools available to the military healthcare system. This advanced toolkit of telemedicine curriculum modules will support the efforts of the DoD to efficiently and effectively apply the latest technological advances in communication and data transfer for improving healthcare delivery. To accomplish this task, projects using telemedicine applications have been supported, so that lessons learned from these experiences can be used in the development of educational curriculum modules designed to teach military and other healthcare providers how to utilize and implement telemedicine technologies. A clinical telemedicine service has been maintained in which a hub of physician specialists in Honolulu are available to primary care providers and patients in rural and/or remote clinics. Additionally, research studies using telemedicine applications at high altitudes and with geriatric populations have been supported.

BODY

I. Development of four core competency modules

Four additional core competency areas for the training of health care providers in the use of telemedicine were identified for inclusion in the curriculum: Live and Asynchronous Modalities, First Responder, Simulation and Virtual Reality, and Patient Education. A brief synopsis of the information covered in each of these modules follows.

Module 7: Live and Asynchronous Modalities

Clinicians employing telemedicine tools must decide whether their needs are served better by asynchronous, store-and-forward (S/F) methodology or by live, real-time, interactive video-conferencing (VTC). Store/forward in its simplest form, consists of digital photographs attached to e-mail messages. In its most complex form, mostly used in radiology, store/forward may consist of high-resolution, digitized images managed by fail-safe computer systems that catalogue, archive, fulfill requests for storage and retrieval, and track access, as is the case for the Picture Archive and Communication Systems or PACS system in radiology. In both cases, telemedicine tools allow experts to expand their geographic scope and provide patients with access to expert advice that may not be locally available. Live and asynchronous tools also enable geographically dispersed participants to interact in group discussions to improve patient care.

A comparison of content, clinical bias, logistics, cost and technical equipment for both store-and-forward and live VTC is outlined in the following table:

PARAMETER	STORE-AND-FORWARD	LIVE VTC
Content	Primarily image evaluation	Direct interaction with people
Clinical bias	Greater emphasis on the written history	Emphasis on interviewing and behavioral nuance
Logistics	Easier to accomplish; can be done with few people involved	Harder to accomplish; many people must coordinate and network connections must be made
Cost	Inexpensive equipment; transmission charges usually nominal (PACs excepted)	Special equipment more expensive; transmission charges may be substantial
Technical Equipment	Widely available, relatively simple to use	Limited manufacturers, relatively simple to use, but complex in technical details.

Module 8: First Responder

With the advent of portable physiologic sensors combined with broadband wireless networks, injured patients may now be monitored remotely. Data collected remotely may be relayed back to control centers for review by emergency physicians or other specialists. This capability extends the reach of the medical facility out to the patient.

Increased monitoring capabilities opens the door for more advanced therapies to be conducted by first responders. Advanced therapies may initially be supervised, telementoring or teleproctoring. As treatment paradigms become more defined, however, this could be accomplished without supervision, but based on local review of physiologic data or automated

therapy similar to defibrillation. First responder therapy based on data from physiologic sensors will require a progressive research and development program to verify that it is safe and effective, and to modify provider training and licensing requirements.

This module will be divided into four sections: 1) communications networks, 2) physiologic sensors, 3) first responders – roles and responsibilities, and 4) regional control centers – roles and responsibilities.

Module 9: Simulation and Virtual Reality

The uses of simulation and virtual reality in medical education, research and clinical care are expanding. Decreasing costs and increasing computing power and bandwidth are leading to affordable and widespread implementations. This module includes basic concepts of simulation and virtual reality in medicine, to include: definitions, utility, components, current status, data/knowledge representation (datasets), artificial intelligence, human computer interface issues, clinical applications, display options, tracking options, use of haptics, and issues regarding degree of realism based on purpose, augmented reality, and procedural simulation.

Module 10: Patient Education

Patient education plays a significant role in health promotion and disease management programs. Improved patient knowledge through patient education helps to involve patients in health care decisions, resulting in better health outcomes. This module is divided into two major sections. The first section will serve as a resource to health care providers for patient education with respect to telemedicine. An electronic toolkit will be developed that includes educational materials and consent forms specific to telemedicine applications. The second section will

discuss the application of telemedicine technologies in support of learning interventions, history taking and interviewing, online connections and support, and telemonitoring. Examples of each application will highlight their ability to support patient-centric disease management.

II. Evaluation of Web-Based Training Techniques

An evaluation plan for measuring the learning outcomes of a telemedicine curriculum for Department of Defense health care providers was drafted (See Appendix G). Questionnaires to measure users' satisfaction with or reaction to each of the first four modules (see Appendix H). Questionnaires to assess the knowledge acquired from each of the first four modules were drafted and revised (See Appendix I).

III. Clinical Consultation Network

In order to gain an understanding of the training needs of telemedicine providers, as well as maintain a "test-bed" to evaluate the utility of the developed curriculum modules, the UH Telemedicine Project has established a clinical consultation network. This network encompasses a central core of clinical consultants operating from the Queen Emma Clinic, Queen's Medical Center, connected to a group of satellite clinics providing medical care to underserved areas throughout Hawaii. Hardware, connectivity, and technical support have been provided to the Telemedicine Clinic within the Queen Emma Clinic. Equipment and connectivity have been provided to remote clinics located at: Hana Community Health Center, Maui, Molakai General Hospital, Molakai, Hilo Bay Clinic and Paholoa Family Health Center, Hawaii, and the Waianae Comprehensive Health Care Clinic and Kalihi-Palama, Oahu.

Dr. Joseph Humphry was able to monitor diabetic patients located at the Hana Community Health Center. Results of these tele-consultations were presented at the national meeting of the CDC Division of Diabetes Translation in St. Louis, MO. Teleconsultations in psychiatry, dermatology, and diabetes are being initiated with patients at Molakai General Hospital.

IV. Curriculum Related Activities

In support of the FIrst Responder Module, physiological sensors were tested in high altitude austere environments, establishing connectivity from a remote area in Hawaii to servers in California.. Results were submitted for presentation to the 13th International Hypoxia Symposium.

In support of the Patient Education and First Responder Modules, potential proposals were formulated for the use of physiological sensors and chronic disease management in geriatric populations.

Representatives from Howard University contacted us congratulating us on the UH Telemedicine Curriculum. One advocate from Howard University is using portions of the curriculum in an undergraduate course.

KEY RESEARCH ACCOMPLISHMENTS

- Six modules completed: Telemedicine Fundamentals, Telemedicine Technology and Environment, Conducting a Telemedicine Patient Visit, Organization and Management, Clinical Telemedicine Consult Simulations, and Case Study: Audiology and Balance.
- Four additional modules identified and under development: Live and Asynchronous Modalities, First Responder, Simulation and Virtual Reality, and Patient Education.
- Evaluation plan for validation of first four modules in development.
- Tests developed to evaluate learning of module content.
- On-line testing and scoring incorporated.
- Initiated contact with AMEDD Center and School for distribution of the curriculum.
- Curriculum being used at Howard University.

REPORTABLE OUTCOMES

Refereed Journal Articles[1]

Humphry, J. & Birkmire-Peters, D.P. The successful integration of telemedicine into the chronic disease model in a rural setting. Manuscript in preparation.

Bangert, D., Doktor, R.H. (2002). Telemedicine as an IS implementation problem: Comparison of dynamics in the USA and India. International Journal of Healthcare Technology and Management, 4(6), 525-541.

Bangert, D., Doktor, R.H. and Johnson, Erik (2002). Preparing healthcare professionals for telemedicine: Results from educational needs research. Journal of Interactive Learning Environments, 10(3), 199-216.

Burgess, L.P.A., Holtel, M.R., Saiki, S.M. & Jacobs, J.L. (2002). Telemedicine in otolaryngology: Implications, pitfalls and roadblocks. Current Opinion in Otolaryngology & Head and Neck Surgery, 10, 194-198.

Holtel, M.R. & Burgess, L.P.A. (2002). Telemedicine in otolaryngology. Otolaryngologic Clinics of North America, 35, 1263-1281.

Bangert, D., Doktor, R.H. and Johnson, Erik (2001). Designing web-based telemedicine training for military healthcare providers. Journal of Continuing Education in the Health Professions, 20(3), 162-169.

Conference Proceedings

Onapa, J., LePape, M.,Thonier, G., Saiki, S., Montgomery, K. & Burgess, L. (2003). High Altitude Research Hawaii. High Altitude Medicine and Biology. In press.

Bangert, D. and R.H. Doktor. (2002). The Role of Organizational Culture in the Management of Clinical e-health Systems, SSGRR (Scuola Superiore Guglielmo Reiss Romoli), L'Aquila, Italy.

Bangert, D. and R.H. Doktor. (2002). Human Factor Considerations in Implementation of a Telemedicine Strategy, American Telemedicine Association, Conference Proceedings, Los Angeles, CA.

[1] See Appendix J

Bangert, David C. and Robert Doktor. (2002). A Cross Cultural Analysis of Human Factor Impediments to Effective Telemedicine Utilization, American Telemedicine Association, Conference Proceedings, Los Angeles, CA.

Bangert, David C. and Robert Doktor. (2001). Causes of Human Factor Barriers to Telemedicine, American Telemedicine Association, Conference Proceedings, Ft. Lauderdale, FL.

Presentations[2]

Onapa, J., LePape, M., Thonier, G., Saiki, S., Montgomery, K. & Burgess, L. (2003, Februray). Altitude Research Hawaii. Poster accepted for presentation to the 13th International Hypoxia Symposium, Banaff, Canada.

Burgess, L.P.A. (2002, December). Pitfalls in Telemedicine and Telesynergy. Presentation given as Visiting Professor, Hong Kong Polytechnic University, Hong Kong, China.

Humphrey, J. (2002, May). Using telemedicine and the chronic disease model to improve quality of diabetes care in Hana Community Health Centers. Presentation to the national meeting of the CDC Division of Diabetes Translation, St. Louis, MO.

[2] See Appendix K

CONCLUSIONS

Significant progress in the University of Hawaii Telemedicine Curriculum project has been made during this time period. The remaining four modules in the curriculum are under development for implementation on the UH Telemedicine Curriculum Website. A modified evaluation plan is also in progress. Completion of the tasks in the statement of work during the original contract timeframe, however, has been delayed due to numerous personnel changes in the project. A seven month no-cost extension has been requested to complete the project.

Appendix A

First Quarter (FY02) Activities

(July 1, 2001 to September 30, 2001)

11th INTERIM REPORT

1. **Agreement No.** DAMD17-99-2-9003 2. **Report Date:** November 2, 2001

3. **Reporting period from:** June 2001 to September 2001

4. **PI:** Richard B. Friedman, M.D. 5. **Telephone No.:** (808) 547-4420

6. **Institution:** University of Hawaii, Office of Research Services
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. **Project Title:** University of Hawaii Telemedicine Curriculum Project

8. **Current staff, with percent effort of each on project. (See Attached)**

9. **Agreement expenditures to date (as applicable):**

	Current / Cumulative		Current / Cumulative
Personnel	$124,356.01 / $1,162,147.43	**Travel**	$ 3,196.48 / $ 58,699.49
Fringe Benefits	$ 13,246.76 / $178,833.19	**Equipment**	$ 5,211.35 / $228,841.10
Supplies	$ 9,096.53 / $135,217.82	**Other**	$ 35,236.00 / $372,585.44

	Current / Cumulative
Direct Costs	$ 190,343.13 / $2,136,324.47
Indirect Costs	$ 37,766.89 / $ 388,991.69
Total	$228,110.02 / $2,525,316.16

10. **Comments on administrative and logistical matters.**

University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. **Use additional page(s), as necessary, to describe scientific progress for the quarter in terms of the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. (See Attached)**

12. **Use additional page(s) to present a brief statement of plans or milestones for the next quarter. (See Attached)**

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Responsibility	Individual	FTE	Effective
Principal Investigator	Richard Friedman, M.D.	20%	04/01/99
Project Manager	Sharee Pepper, Ph.D.	100%	12/04/00
Administrative Secretary	Irene Tanaka	100%	05/26/99
Administrative Secretary	Dolly Puchert	100%	08/01/01
Chief Technical Officer	David Huhta, MBA	100%	06/21/99
Systems Programmer	Mike von Platen	100%	08/02/99
Clinician	Joseph Humphry, M.D.	20%	07/01/01
Clinical Associate	Daniel Saltman, M.D.	10%	04/01/01

Item #11: Description of Progress

Personnel Related Activates:

On June 8, 2001, Irene Tanaka, Administrative Secretary, resigned from the UH Telemedicine Project. Ms. Tanaka continued as a temporary employee as needed until a replacement was hired.

On July 13, 2001, David Huhta, Chief Technical Officer, resigned from the UH Telemedicine Project.

On August 1, 2001, Dolly Puchert was hired as the Administrative Secretary for the UH Telemedicine Project.

Dr. Seong Ki Mun, Ph.D., Director ISIS & Imaging Physics and Professor of Medicine & Radiology at Georgetown University, Washington, DC was invited to interview for the Chief of Research and Development of the UH Telemedicine Project from September 8-14. Dr. Mun visited with a variety of personnel from the University of Hawaii, including the Medical School, the School of Engineering and the UH Telemedicine Project, as well as Tripler Army Hospital and other local telemedicine related organizations.

Curriculum Related Activities:

July 2, 2001 submitted UHTP annual report to TATRC.

The UHTP Advisory Committee met on September 12, 2001. The agenda included a presentation by Dr. Seong Ki Mun on telemedicine applications at Georgetown and the DoD.

A video teleconference with the UHTP and Dr. Rufus Sessions and Jessica Kenyon at TATRC, Ft Detrick, MD and Col Edward Knights, Belinda Ramirez, Velma Burrs, at AMEDDCS, Ft Sam Houston, TX was held to discuss the possible transfer of the curriculum modules. Details associated with the hosting of the UHTP curriculum modules by AMEDDCS were discussed and a copy of the modules was sent to AMEDDCS on a CD disk.

Level 2 evaluation Instruments developed for Curriculum Modules 1-3 by Sharee Pepper.

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific. The Commonwealth Health Center of Saipan (including approximately 40 physicians) began connecting by PEACESAT to these weekly VTC presentations.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Dr. Pepper and Ms. Puchert attended a RCUH (Research Corp. of the UH) workshop on a new computerized personnel data entry system (9/7/01).

Drs. Richard Friedman and Sharee Pepper and Michael von Platen visited Waianae Comprehensive Community Health Center (WCCHC) to discuss cooperative projects, possible telemedicine applications and equipment needs (9/25/01).

On August 29, 2001 Sharee Pepper was the guest speaker for the weekly Kapiolani Woman's and Children's Hospital Seminar Series.

Appendix B

Second Quarter (FY02) Activities

(October 1, 2001 to December 31, 2001)

12th Interim Report

1. Agreement No. DAMD17-99-2-9003   2. Report Date: February 11, 2001

3. Reporting period from October, 2001 to January, 2002

4. PI Richard B. Friedman, M.D.   5. Telephone No. (808) 528-2938

6. Institution University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **SEE ATTACHED**

9. Agreement expenditures to date (as applicable):

	Current / Cumulative		Current / Cumulative
Personnel	$92,466.39 / 1,254,613.82	Travel	$ 3,232.50 / $ 61,931.99
Fringe Benefits	$13,446.15 / $192,279.34	Equipment	$ 36,422.30 / $265,263.40
Supplies	$ 19,985.46 / $155,203.28	Other	$ 34,489.33 / $407,074.77

	Current / Cumulative
Direct Costs	$ 200,042.13 / $2,336,366.60
Indirect Costs	$ 33,378.45 / $ 422,370.14
Total:	$233,420.58 / $2,758,736.74

10. Comments on administrative and logistical matters.

University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in terms
of the tasks or objectives listed in the statement of work for this agreement. Explain deviations where
this isn't possible. Include date where possible. **SEE ATTACHED**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter.

SEE ATTACHED

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

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Project Manager	Sharee Pepper, Ph.D.	100%	12/04/00
Administrative Secretary	Dolly Puchert	100%	08/01/01
Systems Programmer	Mike von Platen	100%	08/02/99
Clinician	Joseph Humphry, M.D.	20%	07/01/01
Clinical Associate	Daniel Saltman, M.D.	20%	04/01/01

Item #11: Description of Progress

<u>Personnel Related Activates:</u>

Dr. Daniel Saltman's percent effort increased from 10% to 20% on 11/1/01. Dr. Saltman is facilitating a UH-Ka'u Hospital Pediatric Tele-psychiatry services partnership to support the Feliz Consent Decree for the State of Hawaii.

Dr. Lawrence Burgess joined the staff on January 1, 2002 as the Director of Telemedicine for the University of Hawaii School of Medicine and anticipated new Principal Investigator for the UHTP.

<u>Curriculum Related Activities:</u>

Advanced Level 2 evaluation Instruments developed for Curriculum Modules 1-3.

National Advisory Board Meeting was held by VTC and phone conferencing on November 12, 001. The agenda was focused on discussing appropriate modules for development during the current renewal period of the UHTP grant (see attached minutes).

<u>Administrative and Other Activities:</u>

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Dr. Pepper attended a workshop on NIH policies, procedures and funding opportunities (11/7-11/9) and a workshop with UCSF School of Medicine on Training in Clinical Research (12/13-14/01).

Dr. Pepper gave talk on telemedicine and demonstration of UHTP curriculum modules to meeting of nurses from Korea sponsored by the Center for Asia-Pacific Exchange (CAPE) on 11/19/01.

Dr. Burgess attended Medical Meets Virtual Reality (MMVR) Conference in Newport Beach, CA (1/22-26/02).

University of Hawaii National Advisory Committee Meeting VTC
Tuesday, 13 November 2001, 1600-1730

Attending - Participants were connected either by video teleconference or by phone:

Dr. David Bangert, UHI
Dr. James Bates, CERMUSA
COL Lawrence Burgess, Tripler Army Medical Center
Mr. Conrad Clyburn, TATRC
Dr. Robert Doktor, UHI
Dr. Richard Friedman, Principal Investigator, UHI
Ms. Jessica Kenyon, TATRC
COL Edward Knights, AMEDD C&S
Ms. Cheryl Miles, USAMRAA
Dr. Leon Moore, USUHS
Dr. Sharee Pepper, UHI
COL Ron Poropatich, TATRC/WRAMC
Dr. Rufus Sessions, GOR, TATRC
Mr. Michael von Platen, UHI

Meeting Highlights:

- The Advisory Board was convened in order to get the group's input on what would be the most valuable modules to develop under the second phase of work. The renewal proposal specifies that four new modules will be developed to extend the basic curriculum.

- Dr. Friedman welcomed the group and summarized the objectives of the meeting.

- Dr. Sessions reviewed some of the recent background for the group. Previously the GOR and PI agreed that instead of developing a series of subspecialty modules, UHI would develop modules aimed at advanced core competencies required to conduct telemedicine. Candidate core competencies were listed in the renewal proposal (page 6):
    - **1 -** Advanced Knowledge in obtaining and handling graphic images, including knowledge of existing standards, issues of resolution, etc.
    - **2 –** Advanced knowledge in techniques associated with store and forward technologies
    - **3 –** Advanced knowledge of real-time teleconsultation
    - **4 –** Understanding the interaction and dependencies between all members of the health care system that are supporting deployed units
    - **5 –** Knowledge of the considerations and details associated with the informatics required to document the patient encounter, history, diagnosis, treatment, etc.
    - **6 –** In-depth understanding of key success factors in the deployment of telemedicine applications
    - **7 –** Advanced knowledge of the capabilities of medical modeling and simulation technologies to enhance medical care

- **8** – Knowledge of capabilities and limitations of telementoring
- **9** – Advanced knowledge of specific medical devices used in telemedicine for diagnosis and/or treatment (microscopes, arthroscopes, endoscopes, robotic arms, and microsurgical devices) and specific issues associated with their use
- **10** – Advanced knowledge for specialized provider groups individualized to medical specialty learning needs
- **11** – How to develop an atmosphere for the adoption of telemedicine
- **12** – How to develop an administrative structure to foster effective telemedicine
- **13** – How to evaluate the cost-effectiveness of new telemedicine applications, including how to evaluate the true costs of a telemedicine application

- COL Poropatich pointed out that while much of the technology connected with telemedicine is likely to change dramatically over the next few years, the users will remain the same. It is important to respond to those groups, to include allied health care workers and combat medics. Dr. Bates was in concurrence with the suggestion.

- COL Poropatich also suggested that the value added by telemedicine needs to come across more clearly in the curriculum – not only to providers, but to patients as well.
  - Module 4, developed under phase I, addresses this issue somewhat.
  - Dr. Sessions pointed out that if UHI should address the patient in the curriculum this would represent a significant change in target audience. Heretofore, the curriculum has only been considered a distance learning resource for those who might execute telemedicine in a clinical or deployed setting.
  - COL Poropatich suggested that addressing the patient would, however, increase the likelihood that telemedicine will be utilized. If patients are aware of it, they can ask for it, and thus the technology may be used more often.
  - Dr. Friedman found the concept of addressing patients interesting, even though it represents a change in direction. The group as a whole was mostly in agreement on this issue.

- Mr. Clyburn mentioned that there is significant interest at the senior leadership level in online distance learning references that could be made available to troops deployed in remote areas.

- COL Poropatich pointed out the need for the curriculum to be Triservice-focused.

- Dr. Sessions stated that TATRC has a number of programs aimed at developing telemedicine and telehealth support materials. Because so many of TATRC/DoD's resources are set to develop telemedicine resources and assets, it is important to be wary of turning resources dedicated to distance learning toward things that already have the lion's share of resources. It is not a good idea to repeat elements in other DoD-funded programs.

- Dr. Bates is in support of addressing store-and-forward techniques in the new modules.
  - Dr. Sessions is of the opinion that this is a core function of telemedicine and that it is already covered fairly well in the basic curriculum developed under phase I.

- COL Burgess stated that he would like for the advisory board to name six potential topics for the new modules, of which two would be labeled essential by the board. This would give UHI the flexibility of choosing two from the remaining four topics. He is of the opinion that the UHI could ethically only develop teaching modules in areas where they have ongoing work.
- This would also give UHI the opportunity to experiment with the remaining four topics to see which two turn out to be the best for the new modules.
    - Dr. Sessions disagreed with this idea and does not see it as an ethical problem for the UHI, with all the expertise that they have developed over the course of the Project, to develop the types of modules that are being discussed. Further, the Cooperative Agreement already specifies the method by which the final decision on the content of the curriculum will be decided, in consultations between the GOR and the PI. Neither the Army nor the University has unilateral authority in the Cooperative Agreement to decide what specific work will be done. That is inherent in the nature of a Cooperative Agreement as opposed to a Grant or a straight solicited contract for work.

- After general discussion of the 13 topics under consideration, Dr. Sessions made a motion for the group to go through the list of topics in the proposal to see which, if any, could be eliminated on the spot through consensus.
    - Eliminated topics, by number: 1, 6, 8, 9, 11, 12 (determined by group consensus).
    - Topics remaining in consideration, by number: 2/3, 4, 5, 7, 10
        - **2** and **3** can be combined. Dr. Bangert said that the division between them is artificial anyway, and that multi-point conferencing could be covered there as well.
        - **4** was kept, without debate.
        - **5** remains in consideration, but the decision was not unanimous. COL Burgess said that it is bioinformatics and only indirectly related to telemedicine. Dr. Sessions, on the other hand, pointed out that #5 is essential to understanding how information captured in clinical encounters is acquired, transmitted, archived, and accessible – this is a root function of telemedicine/telehealth. Mr. Clyburn agreed that it should be left open for consideration.
        - **7**, which addresses medical modeling and simulation, was debated as well. COL Burgess thinks that because there is a lot of interest in this arena that is likely to continue, it is important for the curriculum to address it. Dr. Sessions agreed with the importance of medical modeling and simulation to advanced medical technology in general, but pointed out that TATRC already has a strong R&D program in it, and that the application of MM&S to health care has not yet reached the degree of penetration in telehealth such that it begs to be included in a telemedicine curriculum. Mr. Clyburn mentioned that he is aware that the UHI has recently taken over the Maui High Performance Computer Center. Various groups of influencial people are excited about leveraging these resources, so perhaps the possibility should be left open.

- **10** was kept without debate, since it addresses modules for combat medics and could be expanded to include a module directed towards patients. Regarding a module addressing patients, please refer to the discussion above.

In summary, patients, providers and allied health workers were identified as the three possible target audiences. The following two modules, one directed towards patients and one toward allied health workers, were felt to be high priority by committee members.

1) A generic curriculum module appropriate for patient populations that would give an overview of telemedicine and possible applications. This module would also incorporate some of the information included in the first 5 modules restructured for a different target audience and could be viewed while waiting in an office or lobby.

2) A curriculum module to support first responder allied health workers (e.g. Duty Corpsman, 91 Whisky, and other Tri-Service equivalents). This module could also be useful for rural nurses and civilian practitioners with similar needs.

(Note - these two modules are covered under Number 10 of the renewal proposal, "Advanced knowledge for specialized provider groups individualized to medical specialty learning needs.")

The final two modules would then be chosen from the following options with consensus from the TATRC and UHI staff.

1) Numbers 2 & 3 could be combined to include advanced knowledge in techniques associated with store and forward technologies and real-time teleconsultation. The need to include multipoint consults was also noted.
2) Number 5 – Knowledge of the considerations and details associated with the informatics required to document the patient encounter, history, diagnosis, treatment, etc. including knowledge of basic database technologies involved in telemedicine.
3) Number 7 – Advanced knowledge of the capabilities of medical modeling and simulation technologies to enhance medical care.

Appendix C

Third Quarter (FY02) Activities

(January 1, 2002 to March 31, 2002)

Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: July 19, 2002

3. Reporting period from: January 2002 to March 2002

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

	Current / Cumulative		Current / Cumulative
Personnel	$26,396.38 / $1,297,509.52	Travel	$1,437.30 / $63,369.29
Fringe Benefits	$5,298.40 / $200,126.87	Equipment	$0 / $265,263.40
Supplies	$6307.01 / $160,660.36	Other	$17,915.49 / $417,977.33

	Current / Cumulative
Direct Costs	$57,354.58 / $2,404,906.77
Indirect Costs	$11,700.34 / $436,352.33
Total:	$69,054.92 / $2,841,259.10

10. Comments on administrative and logistical matters.
University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in termsof the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. **See Attached**

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	50%	01/01/02
Project Manager	Sharee Pepper, Ph.D.	100%	12/04/00
Administrative Secretary	Dolly Puchert	100%	8/01/01
Systems Programmer	Mike von Platen	100%	08/02/99
Clinician	Joseph Humphry, M.D.	20%	07/01/01
Clinical Associate	Daniel Saltman, M.D.	20%	04/01/01

Item #11: Description of Progress

Personnel Related Activates:

Sharee Pepper, Ph.D., left position of Project Manager on 02/14/02

Lawrence Burgess, M.D. replaced Richard Friedman, M.D. as Principal Investigator on 01/01/02, with final approval later in the quarter.

Curriculum Related Activities:

The UHTP Advisory Committee met on September 12, 2001. The agenda included a presentation by Dr. Seong Ki Mun on telemedicine applications at Georgetown and the DoD.

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Dr. Burgess attended Medical Meets Virtual Reality (MMVR) Conference in Newport Beach, CA (1/22-26/02).

Dr. Dan Saltman initiated a potential telemedicine initiative surrounding the Felix Decree with Hawaii Health Systems Corporation and community providers.

Appendix D

Fourth Quarter (FY02) Activities

(April 1, 2002 to June 30, 2002)

Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: July 19, 2002

3. Reporting period from: April 2002 to June 2002

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

	Current / Cumulative		Current / Cumulative
Personnel	\$66,506.94 / \$1,364,016.46	Travel	\$5,968.09 / \$67,900.08
Fringe Benefits	\$8,358.90 / \$208,485.77	Equipment	\$ 0 / \$265,263.40
Supplies	\$1,309.87 / \$161,970.23	Other	\$18,692.05 / \$436,669.38

	Current / Cumulative
Direct Costs	\$99,398.55 / \$2,504,305.32
Indirect Costs	\$12,576.30 / \$448,928.63
Total:	\$111,974.85 / \$2,953,233.95

10. Comments on administrative and logistical matters.
University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in termsof the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. See Attached

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	100%	01/14/02
Project Manager	Deborah Birkmire-Peters, Ph.D.	45%	04/29/02
Administrative Secretary	Dolly Puchert	100%	08/01/01
Systems Programmer	Mike von Platen	100%	08/02/99
Clinician	Joseph Humphry, M.D.	20%	07/01/01
Clinical Associate	Daniel Saltman, M.D.	20%	04/01/01

Item #11: Description of Progress

Personnel Related Activates:

Deborah Birkmire-Peters, Ph.D. hired on as project manager.

Curriculum Related Activities:

A conference call with the UHTP and Dr. Rufus Sessions and Jessica Kenyon at TATRC, Ft. Detrick, MD on April 24, 2002 was held to discuss the specific curriculum modules (**see attached minutes**). This was followed up with a meeting on June 3rd (**see attached minutes**), and a follow-up VTC on June 25th. It was concluded what the 4 modules would be for this funding cycle, and how the evaluation would be conducted.

Drs. Birkmire-Peters, Bangert, and Doktor met to develop a detailed evaluation plan for the UH Telemedicine Curriculum. Tests to assess acquisition of module content and to measure participant satisfaction was finalized.

Drs. Birkmire-Peters and Doktor met with William Dendle, UH Compliance Office and Executive Secretary, Committee on Human Studies, to discuss IRB requirements for modifications to the Evaluation Plan.

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific. The Commonwealths Health Center of Saipan (including approximately 40 physicians) began connecting by PEACESAT to these weekly VTC presentations.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Drs. Dan Saltman and Lawrence Burgess initiated a potential telemedicine initiative surrounding the Felix Decree along with the Dept. of Psychiatry, University of Hawaii JABSOM.

Drs. Burgess and Birkmire-Peters attended the 2002 American Telemedicine Association Conference in Los Angeles from June 3-5, 2002, where meetings were conducted with TATRC.

Dr. Joseph Humphry submitted an abstract for presentation entitled: Using Telemedicine and the Chronic Disease Model to Improve Quality of Diabetes Care in Rural Community Health Centers.

Kevin Montgomery, Ph,.D. Stanford UMC, and NASA Ames was a visiting professor providing valuable insight in remote patient monitoring and virtual reality. (April 17-20, 2002)

Bernie Huang, Ph.D., Director of Informatics –Department of Radiology of The Children's Hospital Los Angeles was a visiting professor and gave valuable insight as to how remote data transfer of large data amounts could be accomplished through internet which is critical for telemedicine and virtual reality.

University of Hawaii Telemedicine Curriculum
Teleconference, 24 April 2002, 1600-1730

Attendees	**Affiliation**
Dr. Deborah Birkmire-Peters	UHI
Dr. Larry Burgess	UHI
Ms. Jessica Kenyon	TATRC
Ms. Cheryl Miles	USAMRAA
Dr. Rufus Sessions	TATRC

Summary of Action Items

1. Dr. Burgess will work on potential solutions for evaluating the curriculum.
2. The UHI will maintain an ongoing list of members of their Advisory Committee. The list should be updated regularly.
3. Drs. Sessions and Burgess should continue discussions about a time for a meeting at this year's ATA Meeting in Los Angeles.
4. Jessica Kenyon will provide by e-mail a direct link to the Defense Acquisition University (DAU) presentation, given at the 2000 Internet2Learn Summit, sponsored by TATRC.
5. Generally, continue discussions on the next four modules to be developed.

Minutes

- Purpose of meeting is to discuss project goals and issues raised by Dr. Burgess in his letter to Col Roller (dtd 4 Feb 2002) regarding possible changes to the SOW
    - Work for next phase should include evaluation of the curriculum and development of advanced modules.
- Dr. Burgess stated that he would no longer like to alter the SOW because of the considerable time that would be required to make official changes. Instead, he would like to keep the SOW as it is and proceed with designing four new modules. Dr. Sessions concurred.
- Dr. Burgess said that he would like to develop four new modules, based on the recommendations of the Advisory Committee, which last met in November 2001:
    - First Responder
    - Patient Education
    - Store & Forward v. Live Telemedicine, Multi-point Conferencing
    - Simulation module as applied to distance learning and education
- During the last meeting of the Advisory Committee, there was no controversy surrounding the idea of developing modules for the First Responder and for patient education. There was some disagreement, however, on the other two. Those listed above are the modules that Dr. Burgess would most like to develop.
- Dr. Sessions raised the possibility of an informatics module, but Dr. Burgess responded that the University of Hawaii team does not currently have the expertise to develop such a module credibly. Instead, their expertise is primarily clinical. Dr. Burgess expressed an interest in developing the module, should the project receive additional funding next year.

- Curriculum Evaluation
  - Dr. Burgess has not had success in attempting to get evaluators from Tripler.
    - Staff is 30% depleted because of deployments
    - Staff members are working extra shifts as it is; persuading them to participate in an evaluation is very difficult.
  - Dr. Sessions stated that evaluation is an essential component of the project, and that it is a deliverable in the current SOW.
    - Both pedagogically and scientifically, there is a real need for a credible and valid evaluation of the modules that have already been developed; this is almost more important than developing new modules.
    - Dr. Sessions said that he has been asked repeatedly about evaluation for the UHI curriculum, so the need for it is clear.
    - Funds have already been assigned to the UHI Business School to perform the evaluation, per the cooperative agreement.
    - Dr. Sessions would like to be closely involved in planning for the evaluation.
  - Dr. Burgess has spoken to COL Knights of the AMEDD Center & School, and the AMEDD C&S has a copy of the current curriculum on CD-ROM.
    - Dr. Sessions suggested an online evaluation of UHI's curriculum through the AMEDD C&S.
    - Ms. Belinda Ramirez and Ms. Velma Burrs of the AMEDD C&S, who were involved in earlier discussions about the UHI curriculum, offered to produce an evaluation piece for the project. This is an important avenue for future discussion.
  - Dr. Burgess suggested the possibility of an online evaluation tool. Participants would evaluate the curriculum online in exchange for CME credit. Dr. Sessions agreed wholeheartedly with this idea.
  - DoD evaluators are ideal, but it is not possible to get them, Dr. Burgess mentioned the possibility of getting non-military personnel to do it. Paying an honorarium is customary for evaluations at universities.

- Potential New Topics for Curriculum
  - Advanced Distance Learning
  - Home healthcare
    - Military buy-in for this topic is not great, but Dr. Burgess suggested that renaming it Outpatient or Distance Monitoring would make the topic seem more relevant. Physiologic monitoring of troops has an obvious tie-in with the First Responder. Dr. Sessions concurred.
- Dr. Burgess stated that the UHI is expecting an additional $1 million, next year, to cover a year of work
  - Ms. Miles agreed that it is appropriate to generate a wish list for future work under future funding
  - By mid-summer, the UHI plans to give us a white paper on the work they would do with the additional million.
  - At some point, the UHI will need to reconvene the Advisory Committee to solicit additional recommendations on future work.

- Need to maintain a list of who is on the Advisory Committee, and updated it regularly with any changes.
- Potential meetings at the ATA
    - There will be an *ad hoc* panel on Human Factors this year; Dr. Birkmire-Peters will be present for that panel, as will Drs. Bangert and Doktor.
    - It would be useful to have a one-hour meeting between UHI staff and TATRC, to include Conrad Clyburn. Also, it would be beneficial to have present TATRC personnel who are working on medical modeling and simulation. *ACTION: Should decide when to have this meeting (possibilities include early Wednesday morning or Monday late afternoon or evening).
    - On Saturday, 1 June, there will be a meeting hosted by TATRC for all international and Congressional projects
    - On Wednesday, 5 June, there will be an all-day meeting at which there will be reports on progress in telemedicine initiatives in the last year. MG Martinez-Lopez will be part of this meeting.
        - This meeting is open, so the UHI is invited to join.
    - Dr. Sessions is considering hosting a second Internet2Learn Conference, and may hold a discussion session at ATA this year to follow up on the idea.
        - Dr. Sessions recommends that Dr. Burgess and his colleagues look at a presentation given by Defense Acquisition University at the first Internet2Learn Conference (http://www.tatrc.org/website_i2l/i2l_2000/presentations/Frank_So.htm). Dr. Sessions was very impressed with the overall environment and infrastructure they developed for distance learning.

University of Hawaii Telemedicine Curriculum – Meeting
ATA 2002, Los Angeles, CA
Monday, 3 June, 2002, 1600-1730

Attendees	Affiliation
Dr. Rufus Sessions	TATRC
Ms. Jessica Kenyon	TATRC
Dr. Larry Burgess	University of Hawaii
Dr. Deborah Birkmire-Peters	TAMC/University of Hawaii
Ms. Belinda Ramirez	AMEDD C&S
Ms. Cheryl Miles	USAMRAA

Minutes

- Primary topics for discussion:
  - curriculum evaluation
  - IRB issues
- On 1 June 2001, Dr. Friedman e-mailed to Dr. Sessions and Danny Laspe an amendment to the renewal proposal regarding subjects for the evaluation of the curriculum. The proposal amendment states: "It is our proposal that the curriculum testing will be done on subjects provided by the military. This would be most advantageous as this is the group for which the curriculum is targeted. However, if these candidates are not available, we will test the curriculum on subjects from Hawaii. These subjects may include physicians, nurses, and physician assistants practicing in the community, faculty of the JABSOM and the VA Hospital in Hawaii, Medical Residents in the University of Hawaii JABSOM Residency Program and medical students and nurses from JABSOM."
- Dr. Sessions stated that the evaluation must now take first priority, and also pointed out that some of the project funds are specifically targeted for the evaluation.
- According to the original, FY 98 agreement, the Business School was to conduct the evaluation.
  - Dr. Bangert said that they submitted an evaluation plan before the first two years of the project were over. According to him, an evaluation plan only, not the evaluation itself, was required under the original SOW.
  - The evaluation plan consisted of four parts:
    - assessment of general satisfaction with modules
    - assessment of how much the subject learned from the curriculum
    - assessment of whether the subject later applied what he/she learned from the curriculum (this may not reflect negatively on the curriculum, for example, if the subject has not been working in telemedicine at all)
    - assessment of whether organizational goals have been achieved
  - Dr. Burgess stated his opinion that the third and fourth parts of the original evaluation plan would be difficult to achieve, at best, since for them to be relevant, subjects would have to be involved in active telemedicine programs. He would like to modify the plan to exclude these steps from the evaluation.

- It was suggested that subjects could be asked if they have used telemedicine in the last six months. If yes, then step 3 would be appropriate.

- Dr. Burgess suggested that the University of Hawaii could find subjects and would probably have to pay them honoraria. Potentially, the group of subjects would be a mixture of civilian and military.
    - For military subjects, it might be possible to attract them with an honorarium of sorts. Instead of a direct payment, which they are not allowed to receive, they could make an indirect payment to their TDY funds, or similar.
        - Cheryl Miles agreed to investigate whether or not this approach is feasible.
        - Any appearance of organizational pressure to participate in the evaluation would have to be avoided; this is a potential IRB issue.
    - It may also be possible to recruit reservists for the evaluation.
- Dr. Doktor suggested the possibility of a weekend session for the evaluation, in which there would be no honorarium, *per se*, but the University of Hawaii would pay for participants to stay in a hotel for a weekend, where they would complete the evaluation. Dr. Burgess agreed that this might be a good idea, since it would provide good incentive for participation.
- Dr. Birkmire-Peters and Dr. Sessions emphasized the importance of having each participant evaluate all four modules (excluding the audiology module). The material evaluated should be the same for each participant, in order for data from different participants to be comparable.
    - The original evaluation plan called for each participant to evaluate only a single module. Having each participant evaluate all four would reduce the number of subjects required, and, as a result, may also make it possible to get all military participants.
- Dr. Birkmire-Peters also pointed out that a rigorous assessment of how much was learned from the curriculum is the most important component of the evaluation.
- All agreed to go back and rework the evaluation plan. Dr. Birkmire-Peters is taking the lead and will work collaboratively with Drs. Bangert and Doktor.

Summary of Action Items

- Cheryl Miles agreed to investigate whether it will be possible to pass money through, for example, the Jackson Foundation, in order to pay subjects for the evaluation. This would not be a direct payment, but instead perhaps a payment to their TDY funds or similar. This was noted as a potential IRB issue, as well, both in terms of the money that might be involved and the potential appearance of organizational pressure to participate.
- The University of Hawaii, led by Dr. Birkmire-Peters, is going back to the drawing board on the evaluation plan. Drs. Bangert and Doktor will work with her on this. Unlike the current plan, the new evaluation plan is likely to involve fewer subjects who evaluate four of the original modules, rather than fewer subjects, each of whom only evaluate a single module.
- Set up a VTC for Tuesday, 25 June, at 1500 EST (0900 Hawaii) so that Dr. Birkmire-Peters, Drs. Bangert and Doktor, and Dr. Burgess can present their newly devised evaluation plan.
- Find out if the original FY98 proposal was reviewed by RCQ. Is there any prohibition in the award document against the use of human subjects?
- Cheryl Miles agreed to determine whether the University of Hawaii would be allowed to pay for food for evaluation participants, should it be decided to have a weekend-long evaluation at a hotel, as suggested by Dr. Doktor.
- Dr. Sessions, Jessica Kenyon, and Cheryl Miles will update Danny Laspe by telecon upon return from ATA.

Appendix E

First Quarter (FY03) Activities

(July 1, 2002 to September 30, 2002)

Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: October 31, 2002

3. Reporting period from: July 2002 to September 2002

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
   2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

LINE ITEM	CURRENT	CUMULATIVE
Personnel	$79,916.46	$1,443,932.92
Fringe Benefits	$12,980.64	$221,466.41
Supplies	$16,351.93	$178,322.16
Travel	$4,396.73	$72,296.81
Equipment	$ 0	$265,263.4
Other	$14,627.84	$451,297.22
Direct Cost	$128,273.60	$2,632,578.92
Indirect Cost	$24,607.22	$473,535.85

10. Comments on administrative and logistical matters.
    University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in termsof the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. **See Attached**

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	50%	01/14/02
Project Manager	Deborah Birkmire-Peters, Ph.D.	45%	04/29/02
Administrative Secretary	Dolly Puchert	100%	08/01/01
Systems Programmer	Mike von Platen	100%	08/02/99
Graduate Research Assistant	Kathleen Khimm	50%	08/01/02
Clinician	Joseph Humphry, M.D.	20%	07/01/01
Clinical Associate	Daniel Saltman, M.D.	20%	04/01/01

Item #11: Description of Progress

Personnel Related Activates:

Kathleen Khimm was hired as a 0.5 FTE Graduate Research Assistant. She is a candidate for a M.S. degree in Computer Science.

Curriculum Related Activities:

Dr. Burgess attended the Annual Meeting of the American Academy of Otolaryngology – Head and Neck Surgery in San Diego, California. He serves on the AAO-HNS Telemedicine Task Force. (20 – 25 September 2002).

Dr. Birkmire-Peters gave a presentation to the Hawaii Quality Healthcare Association on evaluation of telemedicine applications (14 August 2002).

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific. The Commonwealths Health Center of Saipan (including approximately 40 physicians) has been connecting by PEACESAT to these weekly VTC presentations.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Drs. Burgess, Birkmire-Peters, Bangert and Doktor met to finalize the evaluation plan design (19 September 2002). It was decided that the most ecologically valid approach was to recruit participants who would read each module on-line at their convenience. After completing each module, each participant will complete a reaction questionnaire to assess their level of satisfaction with that module and a test to evaluate learning of course materials. Participants will be given a two-month period in which to complete the four modules. Each participant will given a voucher for a one-night stay at a local hotel during a specified weekend. During that weekend participants will be interviewed in to determine whether they have been able to or have any plans to implement any telemedicine applications into their environment.

Tests to evaluate learning of course material for each of the four modules were revised. Each test consists of 15 multiple-choice or true-false questions.

Drs. Humphry and Birkmire-Peters are revising a manuscript reporting the integration of telemedicine into the Chronic Disease Model in Hana, Maui.

Appendix F

Second Quarter (FY03) Activities

(October 1, 2002 to December 31, 2002)

Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: January 31, 2002

3. Reporting period from: October 2002 to December 2002

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

LINE ITEM	CURRENT	CUMULATIVE
Personnel	$162,772.48	$1,606,705.40
Fringe Benefits	$31,115.21	$252,581.62
Supplies	$16,958.68	$195,280.84
Travel	$10,481.58	$82,778.39
Equipment	$ 0	$265,263.40
Other	$16,297.00	$467,594.22
Direct Cost	$237,624.95	$2,870,203.87
Indirect Cost	$47,435.09	$520,970.94

10. Comments on administrative and logistical matters.
University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in termsof the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. See Attached

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	50%	01/14/02
Project Manager	Deborah Birkmire-Peters, Ph.D.	75%	04/29/02
Administrative Secretary	Dolly Puchert	100%	08/01/01
Graphics & Systems Programmer	Andrei Sherstyuk, Ph.D.	75%	08/01/02
Systems Programmer	Mike von Platen	100%	08/02/99
Graduate Research Assistant	Kathleen Khimm	50%	08/01/02
Clinician	Joseph Humphry, M.D.	20%	07/01/01
Clinical Associate	Daniel Saltman, M.D.	20%	04/01/01

Item #11: Description of Progress

Personnel Related Activates:

Deborah Birkmire-Peters, Ph.D., Project Manager, increased time to .75 FTE as of 1 October 2002.

Andrei Sherstyuk, Ph.D., Graphics and Systems Programmer was hired .75 FTE as of 1 October 2002.

Curriculum Related Activities:

A conference call with the UHTP and Dr. Rufus Sessions and Jessica Kenyon at TATRC, Fort Detrick, MD on October 9, 2002 was held to discuss the upcoming Product Line Review and four new modules. See attached minutes.

A meeting to finalize plans for the trial run of the High Altitude Study was held (10 October 2002). Participants included: Dr. Lawrence Burgess, Dr. Deborah Birkmire-Peters, Dr. Janet Onapa, Dr. Kevin Montgomery, Michael von Platen, Marc LePape, Guillaume Thonier and Kathleen Khimm.

The trial run of the High Altitude Study was conducted from 12-13 October 2003. The purpose of the trial run was to determine the researchers' abilities to acclimate to the high altitude, to test proposed sensors and communications systems, and to test the proposed logistics prior to the actual study.

A Post-Run meeting was held to review the findings of the High Altitude Study test conducted the previous weekend (21 October 2002). Participants included: Dr. Lawrence Burgess, Dr. Deborah Birkmire-Peters, Dr. Janet Onapa, Dr. John Claybaugh, Michael von Platen, Marc LePape, and Kathleen Khimm. Dr. Stanley Saiki, Glenn Kim, and Guillaume Thonier participated by teleconference. Equipment and study issues were discussed. See attached minutes.

An abstract was submitted for presentation to the 13th International Hypoxia Symposium to be held 19-22 February 2003 in Banff, Alberta, Canada. The abstract discussed the use of Mauna Kea as an accessible laboratory for high altitude research.

Dr. Birkmire-Peters and Dr. Joseph Humphrey met to discuss revisions for a paper presenting the results of a teleconsultation service for diabetic patients between the clinic in Hana, Maui and Honolulu.

Dr. Birkmire-Peters met with representatives of the Mountain Medicine Division at the US Army Research Institute for Environmental Medicine (USARIEM) regarding UH High Altitude Study (15 November 2002). See attached presentation.

Dr. Birkmire-Peters gave a presentation on Telemedicine to the 7th Center for Asia-Pacific Exchange Workshop for Clinical Nurse Specialists (18 November 2002). See attached presentation.

Dr. Birkmire-Peters attended the MedNet 2002 meeting in Amsterdam, The Netherlands (4-7 December 2002).

Dr. Birkmire-Peters gave a presentation on the University of Hawaii Telemedicine Curriculum for the TATRC Product Line Review (12 December 2002). See attached minutes and presentation.

Weekly meetings were held for the Aging in Place (AIP) telehealth project that was designed to demonstrate the feasibility of using telehealth/telemedicine technology to enable elderly to maintain a quality of life and health in their preferred living environment. The project will demonstrate the use of remote monitoring and communication links among seniors and their care management team, including geriatric physicians, nursing specialists, psychiatrists, social workers, case managers and lay caregivers. Participants included: Dr. Daniel Davis, Dr. Brett Flynn, Dr. Patricia Blancette, Dr. Lawrence Burgess, and Kathleen Khimm.

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific. The Commonwealths Health Center of Saipan (including approximately 40 physicians) has been connecting by PEACESAT to these weekly VTC presentations.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

University of Hawaii Telemedicine Curriculum: Telephone Conference
Wednesday, 9 October 2002

SUBJECT: Distance Learning Product Line Review (PLR) and Progress Report

Participants	Affiliation
Dr. Rufus Sessions	TATRC
Ms. Jessica Kenyon	TATRC
Dr. Lawrence Burgess	University of Hawaii
Dr. Deborah Birkmire-Peters	University of Hawaii

Minutes

This PHONCON was arranged in order to discuss an upcoming TATRC Product Line Review (PLR) on Distance Learning, which is scheduled for 12 December. The University of Hawaii's Telemedicine Curriculum is slated to be briefed at that PLR. Once the issues of the PLR were discussed, Dr. Burgess gave an update of progress to date on the project.

1. Annual Product Line Review (PLR)
   a. A PLR is a management tool created in-house at TATRC to provide an external peer review of all research products by subject-matter experts from the DOD. Reviewers are primarily from DARPA, DOD R&E and Acquisition with scientific and medical credentials. Reviewers represent the customer base.
   b. The Distance Learning PLR is scheduled for 12 December 2002 at TATRC.
   c. TATRC PLRs have evolved into a standard format, with a standard template set of PowerPoint slides that are provided to presenters. Projects are briefed according to a taxonomy (e.g., distance learning, distance medicine, etc.).
   d. Ideally, PIs give project briefings, though if the PI is unavailable, the COR or Project Officer may substitute.
   e. Dr. Birkmire-Peters will make a 30-minute presentation on the UH Telemedicine Curriculum.

2. Progress Report
   a. Curriculum Evaluation
      1. The protocol for the curriculum evaluation is to go to the University of Hawaii IRB in mid-October
      2. Dr. Burgess has received preliminary word that the protocol should be exempt.
      3. Once the Hawaii IRB has approved the protocol, it will be forwarded to MRMC for review.
      4. Dr. Burgess reiterated that the evaluation is going to consist of a combination of direct, one-on-one interviews with people who have taken the curriculum, tests, and online evaluation.

   b. Technology transfer of Military Unique Curriculum

1. Transfer of curriculum to the AMEDD Center and School and to TATRC was discussed.
2. Could possibly provide a platform for evaluating pedagogy.
3. COL Robin Tefft, AMEDD Center and School, is the POC for the content of the Military-Unique Curriculum Web Site (MUCWS).
4. TATRC will need to decide how to put it on their website or UH can provide the platform to them.
5. Dr. Burgess mentioned that he envisions transferring all the curriculum modules to the MUCWS. (Note: Dr. Burgess later determined that they would have to develop their own platform, since the MUCWS platform is quite different, and changing the original platform would be too difficult at this point.)
6. Drs. Burgess and Birkmire-Peters agreed to provide minutes of this PHONCON, which are to include a more thorough description of plans to interface with the site.

c. Modifications to UH Telemedicine Curriculum requested by Dr. Sessions.
   1. Add a link for coordinations
   2. The Curriculum should list a credit at the beginning stating that the project was funded through the UH-MRMC Cooperative Agreement. In addition, the cover of the curriculum CD-ROM should include the same information.
   3. Update information in the "talking heads" portion of the curriculum. Dr. Sessions suggested getting the CG of MRMC to do this. TATRC was to see if this was possible.

3. New modules for the UH Telemedicine Curriculum were presented by Dr. Burgess.
   a. Patient Education
      1. Purpose is to educate patients on telemedicine encounters, i.e., what a patient needs to know prior to a telemedicine encounter.
      2. Provides patient-centric feedback.
      3. Two-sided module
         a. First side is written for patients.
         b. Second side is written for health care providers.
   b. First Responder
      1. Written for relevance to the combat medic providing tools for use in the field.
      2. Module addresses how telemedicine could also be used by civilians.
      3. Looking at standards for wireless. Provides baseline for wireless networks and structure.
   c. Store/Forward vs. VTC
      1. Will discuss reimbursement issues.
      2. Will cover scheduling.
      3. Will discuss issues surrounding delivery of telemedicine
      4. Will discuss difficulties in implementing telemedicine through both store/forward and real-time video-teleconferencing.
   d. Simulation

1. Will discuss simulation as a distance learning tool. Will cover broadband and ACCESS technology.
2. Presents a primer on 3-D environment.
3. Education for both patients and providers.
4. Dr. Sessions mentioned that there may be high potential for interaction with TATRC on this topic, and referred to projects managed by Dr. Gerry Moses in the Clinical Applications Division (CAD), such as OR of the Future.
5. Module will serve as a primer for the person who is not knowledgeable about simulation technology. Opportunity to bring in the high-end in which TATRC is well-versed.

e. Databasing as it relates to telemedicine.
   1. Dr. Sessions raised the issue about the potential substitution of a module on databasing concepts in telemedicine for the module on simulation. This possibility arose from discussions with Dr. Friedman et al. on the advanced modules, as well as discussion at the Advisory Committee meeting in November 2001.
   2. Decision was made earlier to do this in the next funding cycle, but not funded.
   3. UH does not have the expertise or the capabilities to address this currently.
   4. Dr. Sessions suggested that there may be existing content available to cover the topic of informatics, and will consider ways to include this sort of content in the curriculum. Potentially, there may be an opportunity to take advantage of Dr. Jaques Reifman's expertise in this area.

4. Action Items
   a. UH will provide first draft of minutes of concall, which should include a detailed explanation of plans to interface with the AMEDD C&S's distance learning programs.
   b. Ms. Kenyon will send templates to UH for the Product Line Review.
   c. Dr. Burgess has agreed to cite TATRC/USAMRMC on the Curriculum web site and on the CD-ROM label.
   d. Dr. Sessions will begin thinking about ways to include an informatics module in the Curriculum.
   e. Dr. Sessions will work on getting a comment from MG Martinez-Lopez endorsing the Curriculum.
   f. A site visit by Dr. Sessions is planned for sometime in the January – February 2003 timeframe. It is also possible that he will join Conrad Clyburn and COL Poropatich when they visit the University in December.

High Altitude Study—Post Trial Run, meeting notes

Date: Monday, 21 October 2002

Attended: ***Lawrence Burgess MD*, Dir. of UH Telemedicine**
Deborah Birkmire-Peters, PhD, *Research Manager UH Telemedicine*
Marc A Le Pape, *PhD student, Computer Information Science, Climber*
Mike Von Platen, *Systems Programmer/Administrator UH Telemedicine*
Janet K. Onopa MD, *PI for project, UH Dept. Medicine*
John Claybaugh, PhD *Physiology, Dept of Clinical Investigations, Tripler*
Kathleen H Kihmm, *Research Asst., UH Telemedicine, grad student computer science*

By teleconference:
Stanley M. Saiki, M.D., *Dir Pacific Telehealth and Technology Hui*
Glenn Kim, *Senior Project Manager, Pacific Telehealth and Technology Hui*
Guillaume Thonier, *Researcher, Biocomputation Center, Climber*

Equipment

- There were some problems on the sensor connections (esp. with pulse-ox parts). New sensors will be available in March (ready in January for testing). New sensors will be moved to center of the body.
- Interface seems too complicated. Guillaume will simplify the display for the pulse-ox and heart rate.
- Adhesive products such as Mastisol may be used for better skin contact.
- Respiratory rate monitoring needs to be improved (better methodology or sensors).
- Pulse-ox sensor is not reliable below 80%. Does the current pulse-ox device take accurate readings at the summit?
  - Jeff Gertsch is using one that is specially designed for high altitude (around $267). Will be available for the spring.
  - Dr. Onopa will look into acquiring a second unit.
  - Tape-on finger pulse oximeter may be better for sleeping.
- X-ray equipment
  - For the study, where the x-ray equipment will be located has to be determined. At Hale Pohaku?
  - Will connectivity to the Internet be an issue (Mike will look into this)?
  - Cost was $1200 to ship via airfreight—is there cheaper alternatives?
  - Need to hear from Stephanie Nagata to verify if it is okay to take x-rays.

Study

- What physiological data will be measured? Pulse-ox, heart rate, blood pressure, EKG, respiratory rate?
- Not everyone will have the full monitoring gear.
- Everyone's pulse-ox will be taken.
- Should fainting episodes be part of the screening?

- Will there be an echocardiographer for the study? Will Pearl Whittaker be able to go?
- Dr. Onopa may not be able to go up to the summit in April.
  - Possibly get another MD from UH (Drs Andy Nichols or Michele LaBotz from sports medicine?)
- At least 2 tech people will be needed in April to take care of sensor and network.
- Do protocols for study need to be changed?
- Dr. Seiki will talk with Dr. Onopa to write in the x-ray information in protocol.
- Write abstract for 13th International Hypoxia Symposium held on 19-22 February 2003 at Banff Mountain Centre, Banff, Alberta Canada. Present a paper as an accessible lab for high altitude study.
  http://www.hypoxia.net/banff2003.asp
- Outside funding resources?
- Marc and Deborah will work on power point presentation. Mike will do images.

Abstract submitted for presentation to the 13th International Hypoxia Symposium, Banff, Alberta, Canada.

HIGH ALTITUDE RESEARCH HAWAII

Janet Onapa[1], Marc Le Pape[2], Guillaume Thonier[3], Stanley Saiki[4], Kevin Montgomery,[3] and Lawrence P.A. Burgess[1]

John A. Burns School of Medicine, University of Hawaii[1], University of Hawaii[2], Stanford University[3], and Department of Veterans Affairs[4]

High altitude research is difficult due to isolated locations with extreme environmental conditions. We are in the early stages of developing a high altitude research laboratory at the Mauna Kea Summit (4205m). A primary concern in this initial effort was to establish broadband connectivity to the summit for the real-time transfer of physiologic and other data. The summit's location has several advantages. Hilo Airport is one stop away from major connecting airports through Hawaii's inter-island network of commercial jet aircraft. Travel to the summit from the airport (and sea level) is a 90-minute drive over good roads, with snow being an infrequent factor. A hospital is 60 minutes away. Hale Pohaku (2800m) is 20 minutes from the summit, and serves as the main support area for lodging and logistics. It is ideally situated to acclimatize and support staff and subjects. The summit's main research building accommodates up to 25 people, with the lack of plumbing being the only negative. The building has been wired with 2 phone lines and broadband IP connected to the University of Hawaii's network with a D3 connection. We successfully accomplished transfer of multiple types of data outside of the University network to Honolulu and Stanford University. Data consisted of the following: live streaming physiologic data using NASA-Stanford developed systems (pulse oximetry, 2-lead EKG, heart rate, respiratory rate), live video teleconferencing, live audio from a digital stethoscope, and transmission of x-ray images. The Mauna Kea Summit is an ideal site for a high altitude research laboratory due to its unique location, good facilities, and broadband connectivity. With further development, we hope to open Mauna Kea as an international site for high altitude research.

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Summary of Site Visit to USARIEM
Deborah Peters
November 15, 2002

1. Dr. Birkmire-Pters met with Dr. Allen Cymerman who is a physiologist and Mountain Group Team Leader, Thermal and Mountain Medicine Division at US Army Research Institute for Environmental Medicine (USARIEM). After touring the facilities, I gave an informal presentation reviewing the dry run that was conducted in October for the UH High Altitude Study to a small group of researchers. I stated that our ultimate goal was to establish a High Altitude Research Center on Mauna Kea.

2. Dr. Birkmire-Peters met individually with researchers from the High Altitude and Biosensors groups. Specific issues, comments and concerns follow:

a. Dr. Allen Cymerman: His major interests are in finding physiological measures that are predictive of AMS over which individuals have no control, i.e., autonomic nervous system responses. He previously looked at a performance measure, i.e., balance, but found that people could accommodate. Currently, he has data to support the use of pupil diameter as an indicant of AMS.

He considered being an associate investigator on the UH High Altitude Gingko Study, but choose to be a consultant. This was largely on the advice that in the event of an adverse event, the US Army could receive considerable negative publicity and the Army had little, if any, control over the investigation. He did have several concerns about the study that he expressed. One is that he believes that more medical staff is needed to oversee the number of subjects that are being run on any one trial. The second is that he believes that the Lake Louise instruments significantly overestimate AMS. He believes the Environmental Symptoms Questionnaire – C (ESQ - 67 questions) is a better measure. A modified version of the ESQ that only contains 22 questions is being used in addition to the Lake Louise instruments. The group at ARIEM is working on a shorter ESQ, but that it has not been validated. This shorter version may be the same as the one being used in the UH study.

He also told me that the University of Colorado at Boulder is currently developing a high altitude research center. It is being directed by Robert Roach and Ben Honigman. He gave me contact information for both of them.

His office number is: 508-233-4851 and email address is: allen.cymerman@na.amedd.army.mil.

b. Dr. Beth Beidleman: She is a physiologist who recently completed her PhD. Previously she worked in the High Altitude group, but is now working with Reed Hoyt in the Biosensors group. She expressed real interest in the data, but had a number of issues about the sensors. One was that she thought that we should be validating our measures against a gold, or at least known, standard. For example, she stated that SpO_2 monitors are notoriously variable. Typically, ARIEM does not validate their SpO_2 measures against the gold standard, i.e., arterial blood samples, but use capillary blood samples with a deep finger stick, and validate against the PaO_2. They are experimenting with several alternative sensors for measuring SpO_2, including a patch on the forehead.

A second concern was what Kevin was doing about Nexan sensors since they've gone out of business. I gave her Kevin's contact information and she said that she would be calling him.

In general, however, she was very enthusiastic about the prospect of the HARC on Mauna Kea. She did add that due to the current push for the Transformation of the Army, that there was not a large amount of money available for basic research. Most of the money is now in Reed Hoyt's group for the development of biosensors. But, she also added that basic research frequently gets incorporated into the biosensor development work.

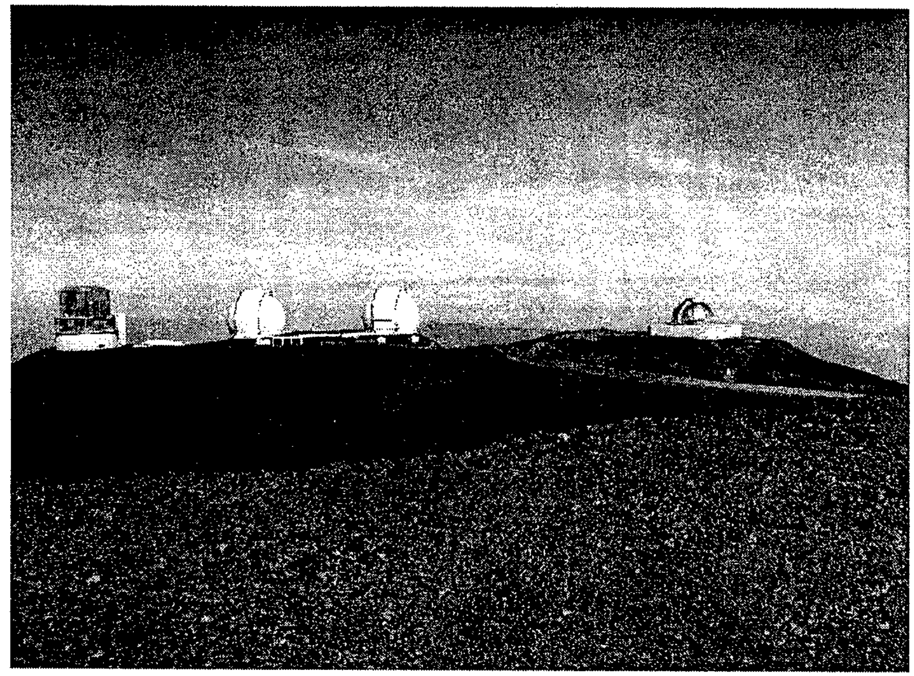
Her office number is: 508-233-5088 and her email address is: beth.beidleman@na.amedd.army.mil.

c. Dr. Stephen Muza: He pointed out that there are limitations to using SpO_2 as a physiological indicator of AMS. It is very accurate at the extremes, but there is a range between the high and low values, however, where it is not predictive of AMS. He is interested in determining what physiological indicators are predictive in that range. There is an effort at ARIEM to gather a large database of physiological data and model the relationship to AMS. For that reason, he is also very enthusiastic about the HARC on Mauna Kea.

His office number is: 508-233-4894 and his email address is: stephen.muza@na.amedd.army.mil.

3. In summary, my interpretation was that the group at ARIEM is very interested in the establishment of the HARC at Mauna Kea for the reasons stated above. In addition, they liked the fact that it was usable year round. Dr. Beidleman stated that they can only do one study a year at Pike's Peak because of the weather. They also appeared to find the large potential subject population available from nearby military bases appealing. And the fact that it's Hawaii did not hurt in the least!

Hawaii High Altitude Research Project



ASTROBIONICS

STANFORD UNIVERSITY MEDICAL CENTER
NATIONAL BIOCOMPUTATION CENTER

NASA

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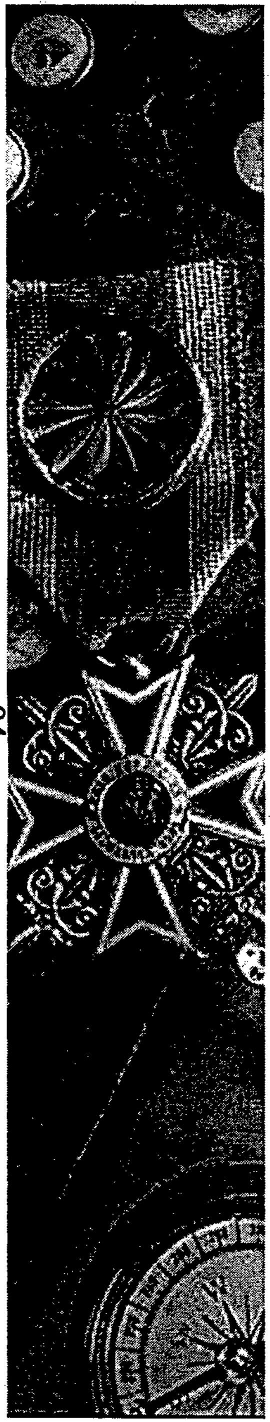


Project Overview:

Joint Telemedicine Deployment Test- Mauna Kea Volcano, Hilo, Hawaii

- Joint work with University of Hawaii John A. Burns School of Medicine:
  - POC: Larry Burgess, MD
    - Associate Dean, Clinical Affairs, UH School of Medicine
    - Director, UH Telemedicine Project
  - Spin-off of existing collaboration for surgical simulation
- Long-term goal: Evaluate idea of establishing a High Altitude Research Center on Mauna Kea summit
- Short-term research goal: Clinical trial to evaluate effectiveness of Ginko Biloba to traditional drugs (acetazolamide) in the prevention of Acute Mountain Sickness (AMS)

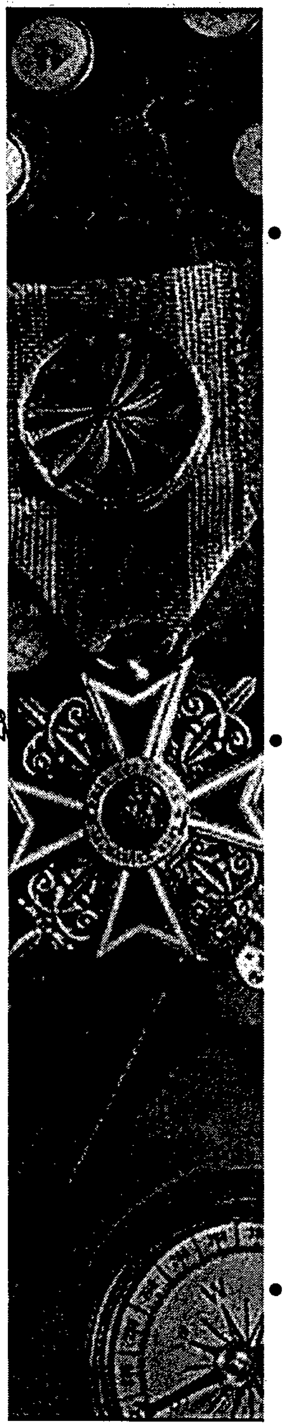
Why care about AMS?

- Literature shows 80% of people get sick within 48 hours of rapid ascent >12,000ft
- Other effects:
  - High altitude pulmonary edema (HAPE)
  - High altitude cerebral edema (HACE)
- Need to maintain performance even when rapidly inserted into high altitude environment

Why?

Mauna Kea volcano, Hilo, Hawaii

- Mauna Kea is one of only places in the world where one can go from sea level to >13,000 ft in about an hour
- Military has immediate need for high altitude physiological research
- Are rapidly taking soldiers from ~sea level and deploying in austere mountainous environments and they need to be immediately effective
- Need to develop ways to protect soldiers against effects of immediate acute mountain sickness
- Evaluate how to prepare soldiers and others for rapid high altitude insertion
- Perform physiological monitoring and use as testbed for austere, remote environments (NASA and military needs)
- Real-world testing will help us harden existing systems

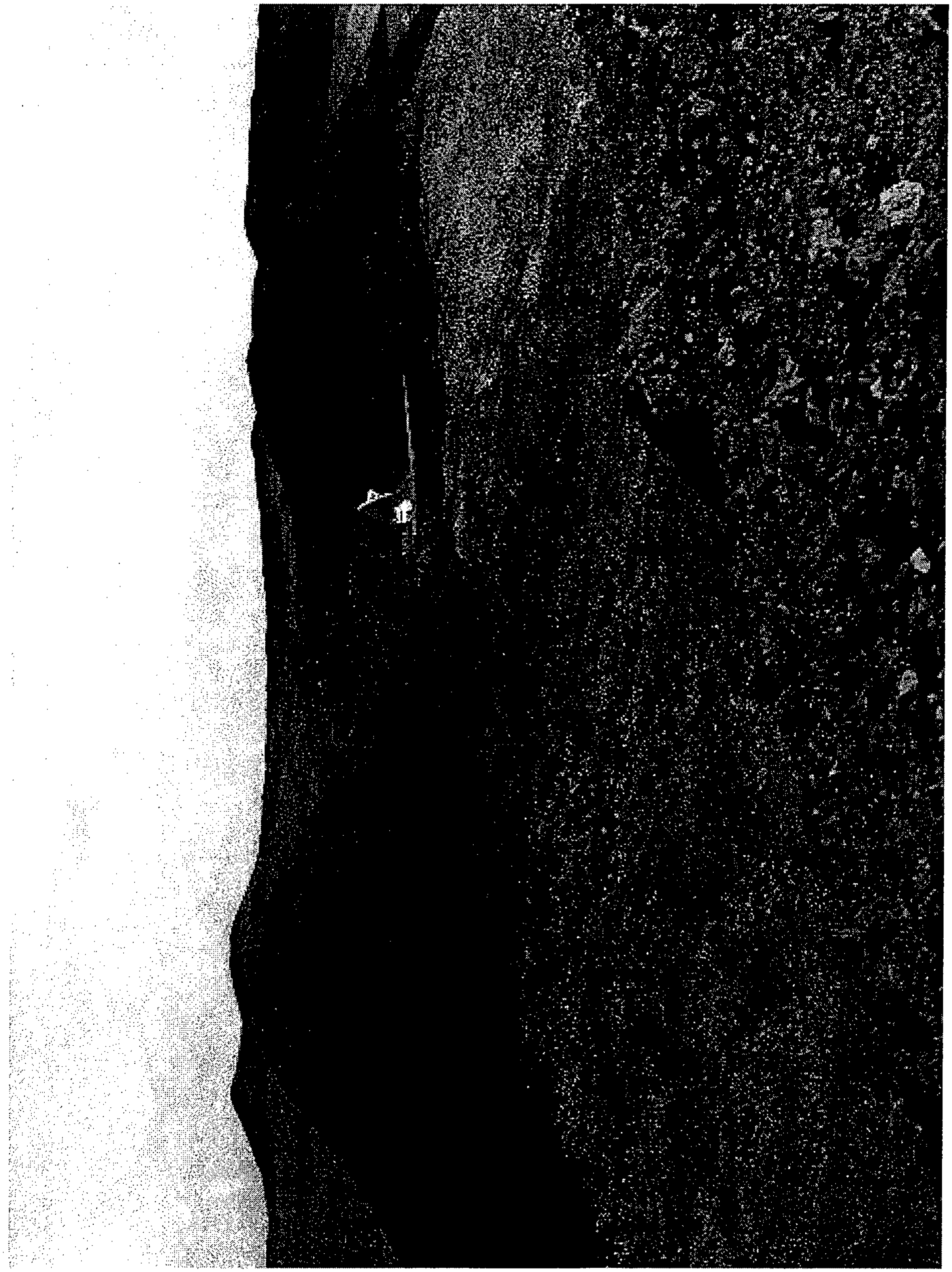


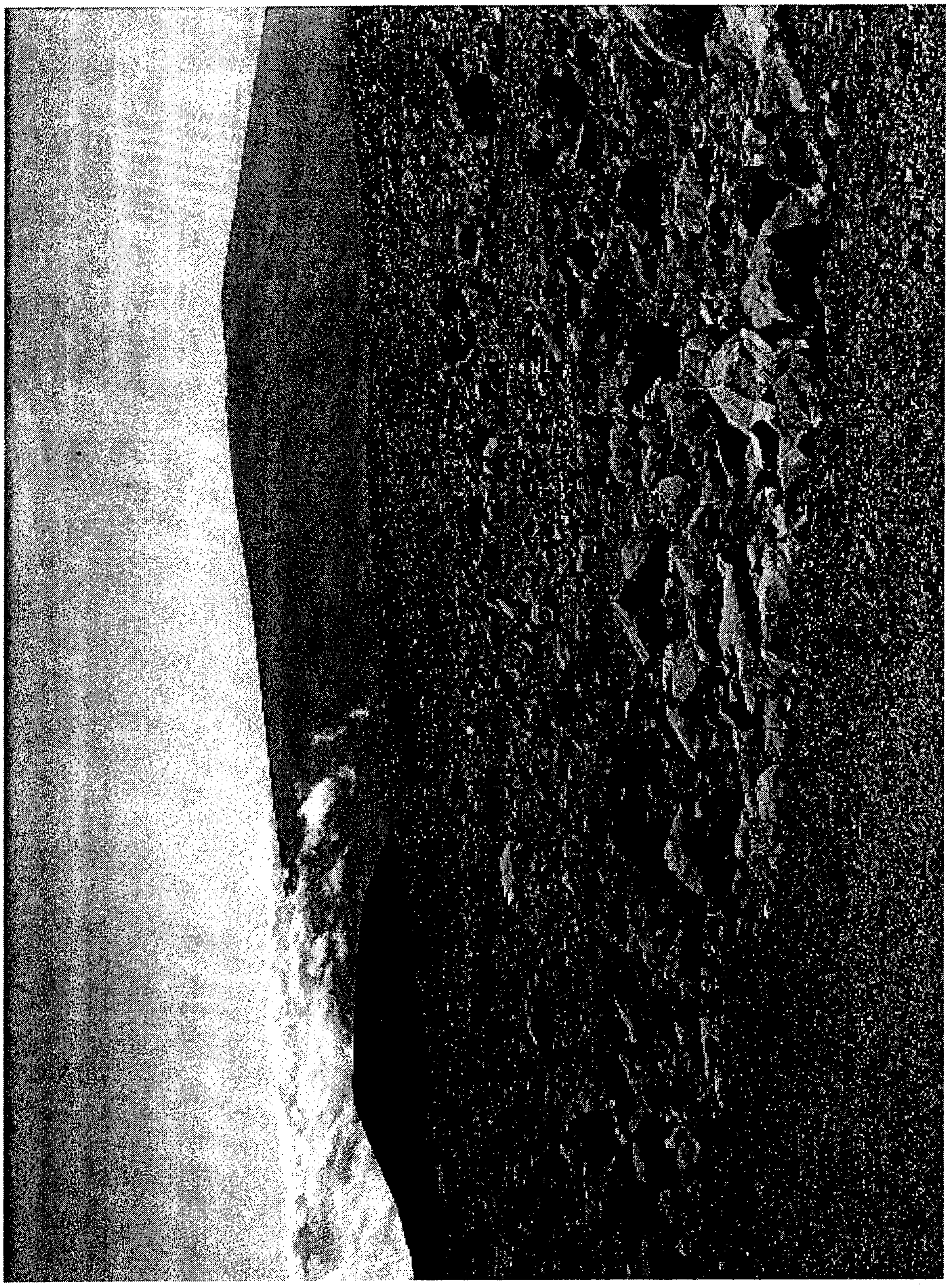
Project Details:

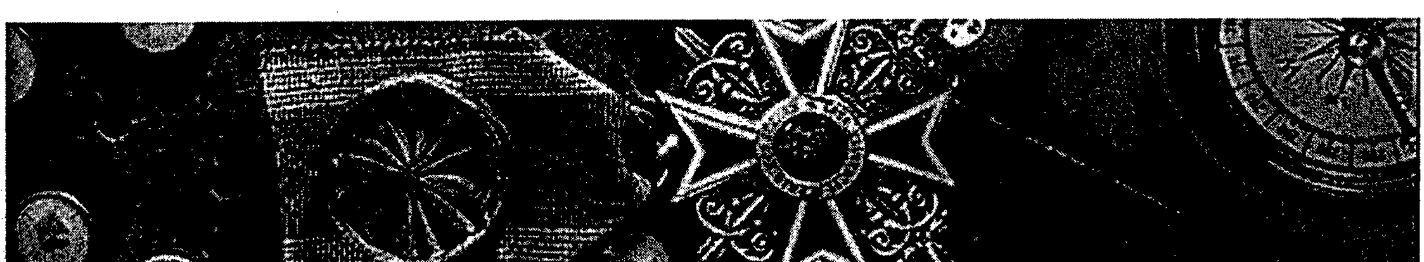
- Tests:
  - Initial trial: (October 02)
    - **6 researchers ascended Mauna Kea to test equipment, procedures, etc.**
    - **First night base camp (9000 ft.), ascend to summit next day**
  - Real study: (April 03)
    - **3 different groups of 20 climbers + 5 staff to rapidly ascent Mauna Kea**
    - **Duration of test is 30 hours**
- In both cases:
  - Subjects wear Nexan sensors wired to iPaq with local logging to CF memory card
  - Wireless is out due to interference with radio telescopes on peak
  - Measuring: 2-lead ECG, SpO2, HR, respiration rate, temperature
  - Will indicate local alarm if parameter out of range
  - Will periodically remove card, plug into laptop and view locally or downlink over net connection
  - Remote viewers at U of Hawaii with videoconference/audio link
- May also use digital stethoscope and downlink audio to UH

Location Details

- Mauna Kea summit: 13796ft
  - Base camp (Hale Pohaku): ~9000ft
- Part of Mauna Kea Scientific Reserve- leased from state to UH
- 13 working telescopes
  - Operated by NASA Institute for Astronomy
  - No wireless allowed (radio astronomy)
- Austere, remote environment (Mars-like)

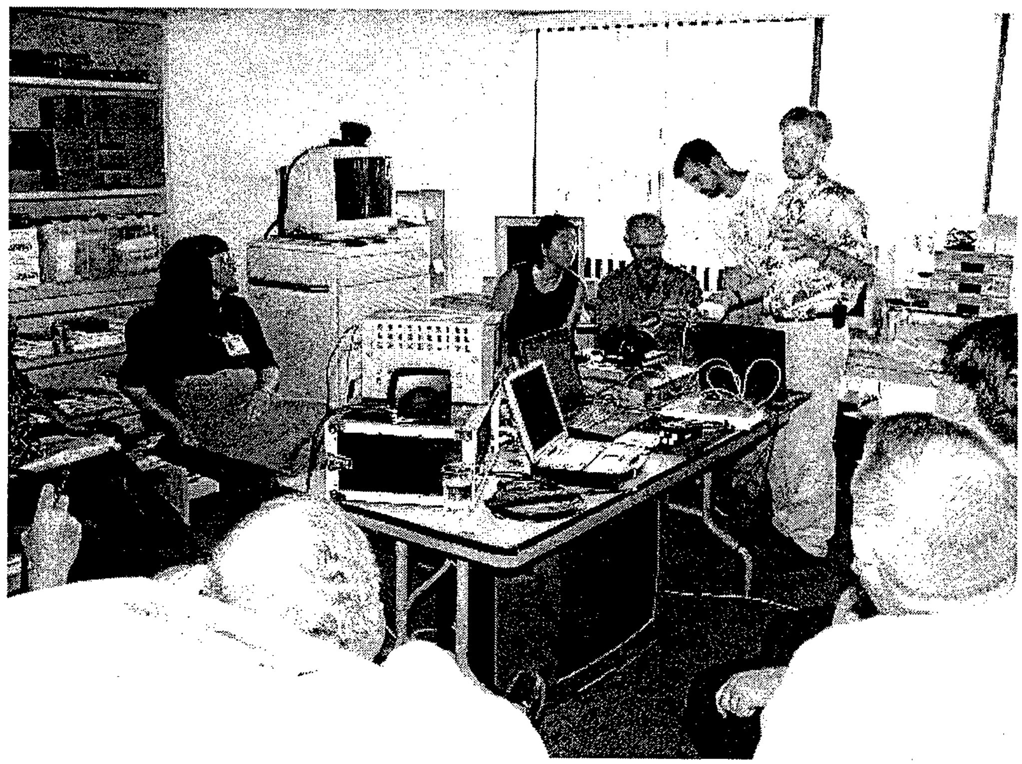






Preparation

- **UH Telemedicine Project office in Honolulu**
  - **"Mission Control"**



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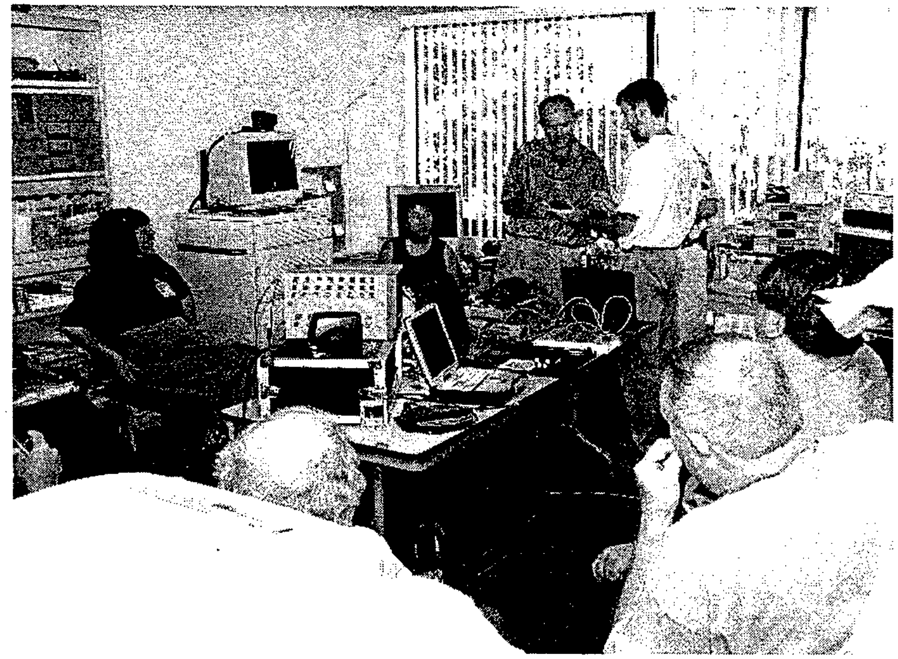
Team



Summit Team:
- Janet Onopa, MD - PI
- Pearl Whittaker, RN
- Guillaume Thonier
- Mike von Platen
- Mark le Pape
- John Claybaugh, PhD

Mission Control:
- Larry Burgess, MD
- Kevin Montgomery, PhD
- Kathleen Kihmm
- Stan Saiki, MD
- Deborah Peters, PhD

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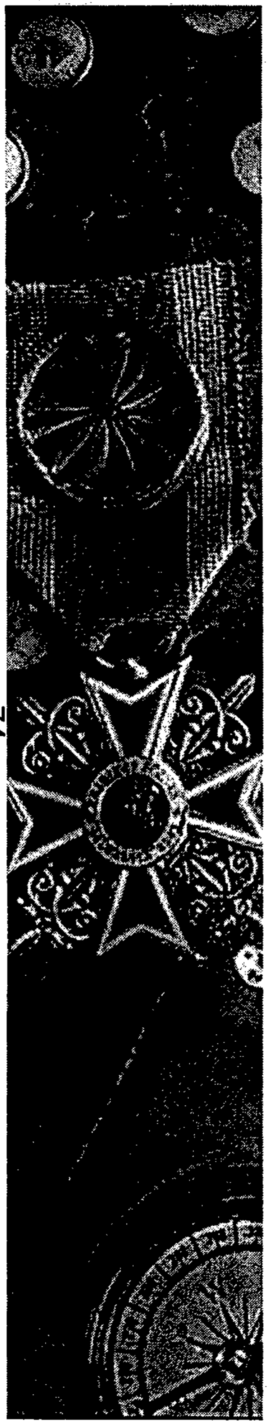
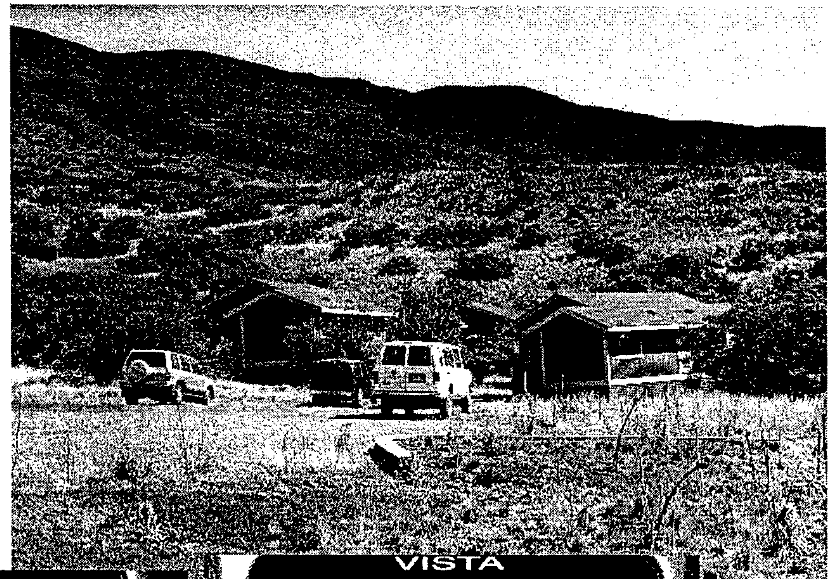
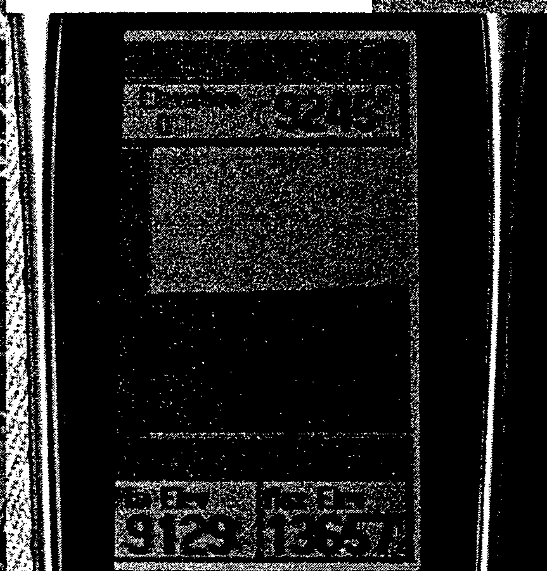


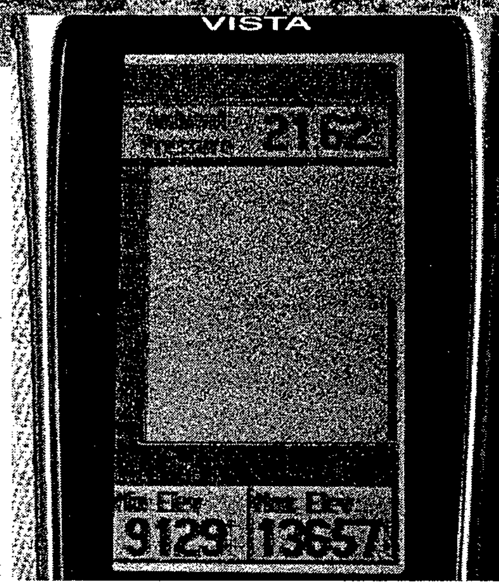
Day One - Friday

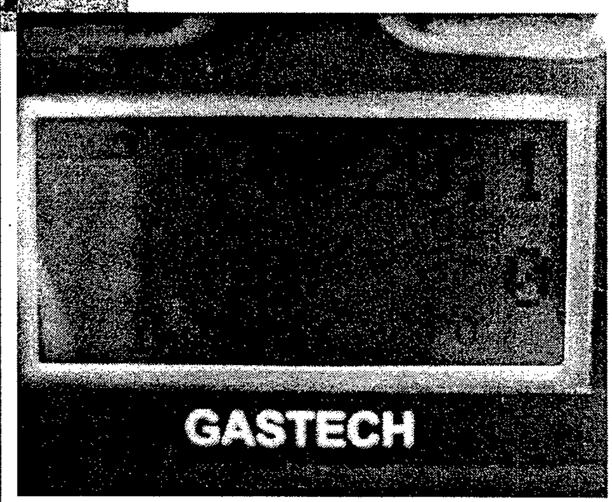
- Guillaume, Mike, and Mark ascended to top to test Internet connection while still had support
- Took environmental readings (barometric pressure, O2 %, altitude (GPS, barometric)) during ascent
- Almost all research goals accomplished on the first day:
  - Physiological logging and streaming (wired ether)
    - SpO2: Mike = 79%, Guillaume = 86%
  - Digital stethoscope deployed and tested
  - X-ray unit deployed and images transferred
- Spent 4-5 hours at SUMMIT, then slept at base

Base Camp:
Hale Pohaku 9245 Feet

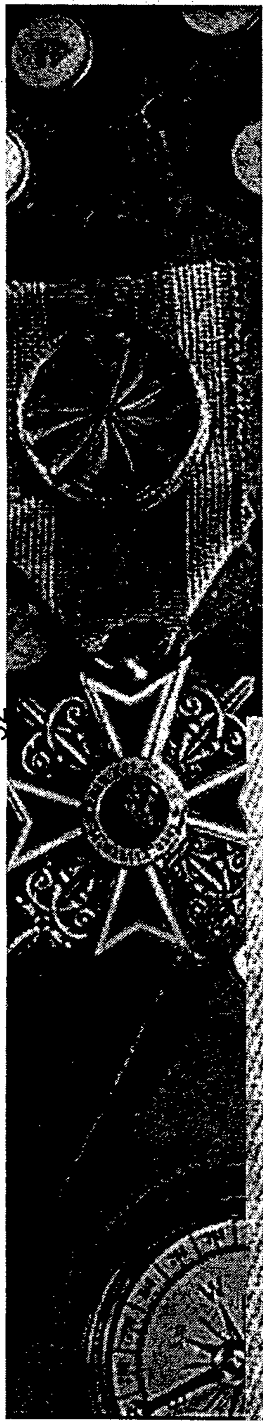


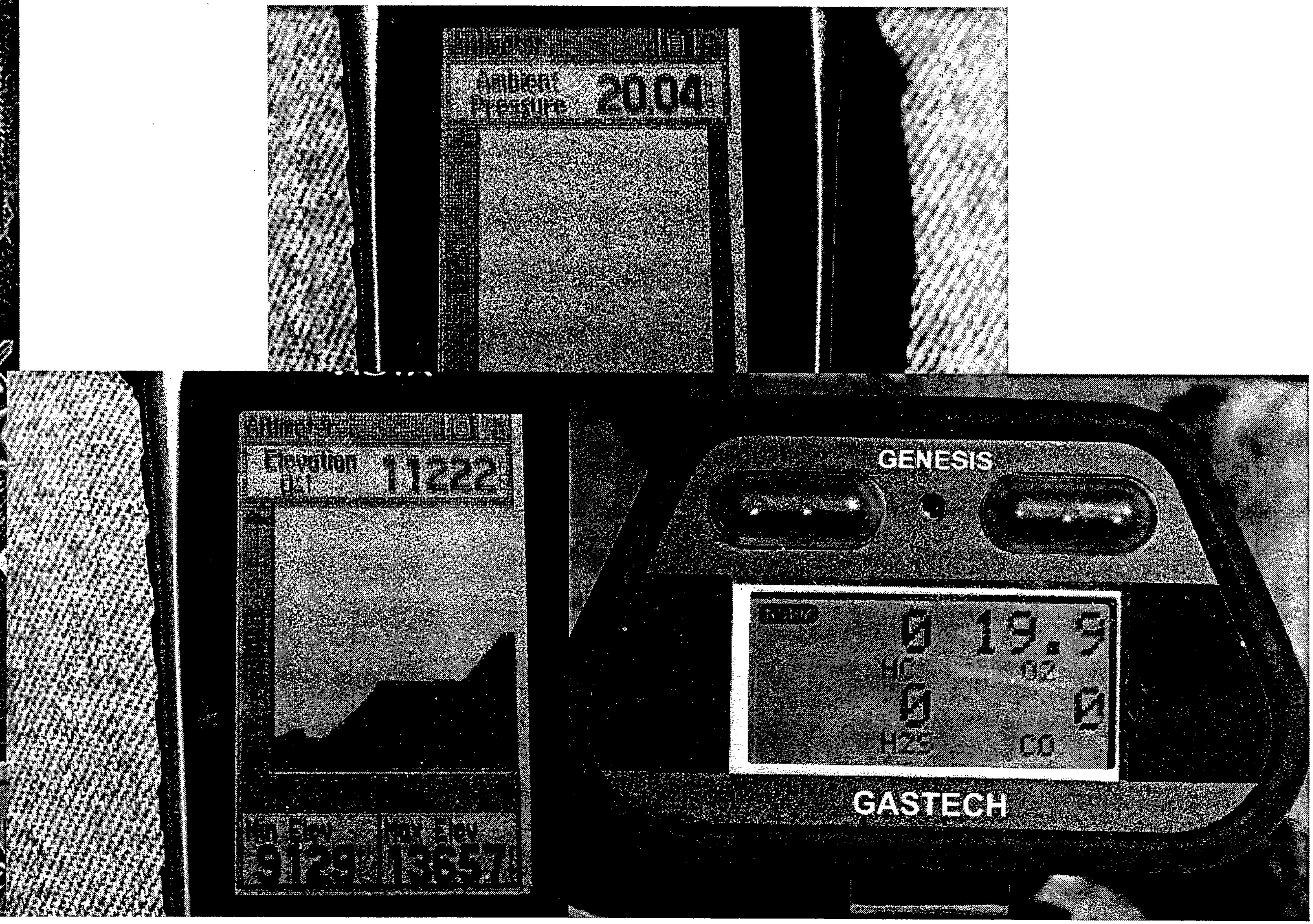




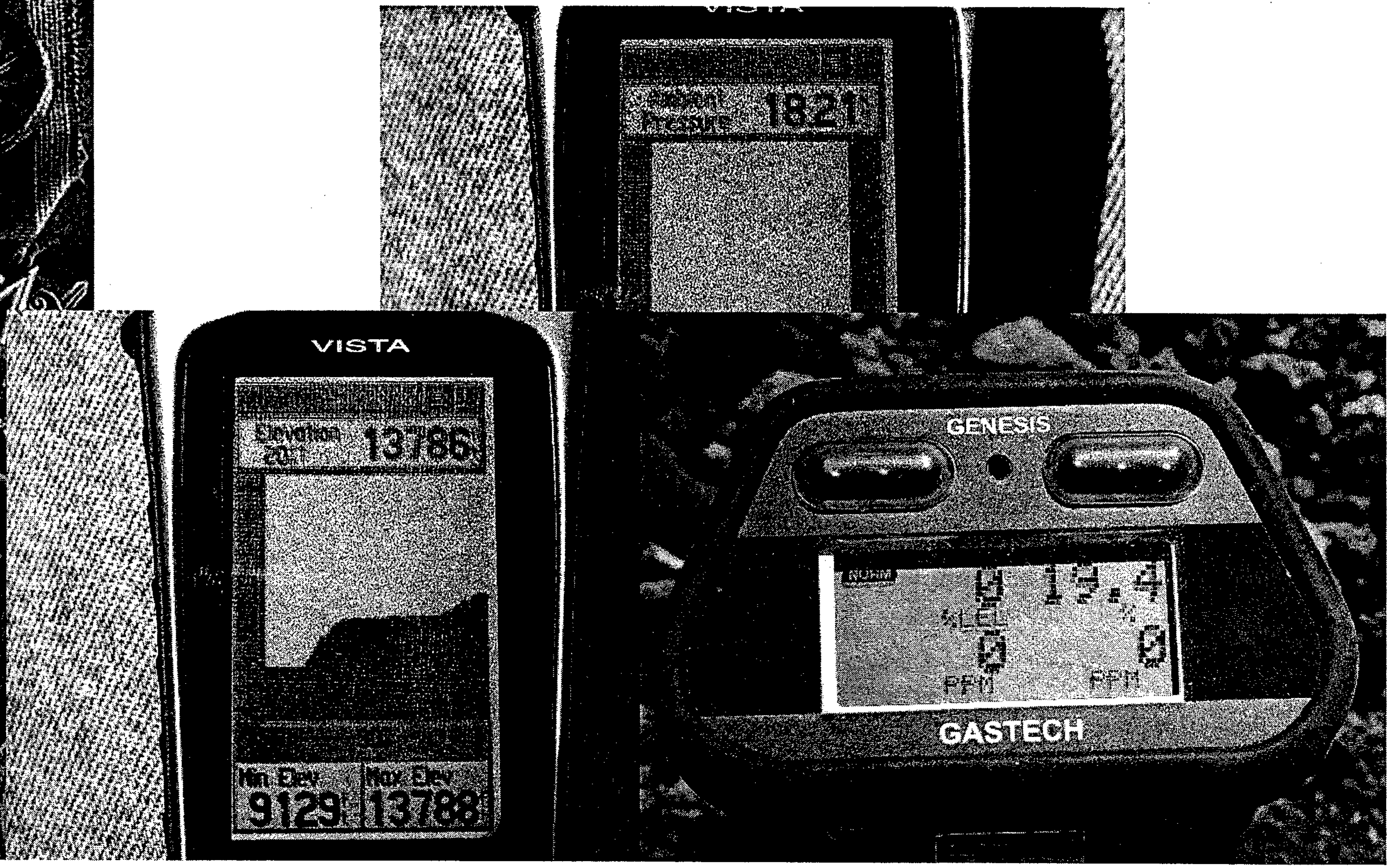


Ascent: 11,222 Feet





Ascent: Summit 13,786 Feet



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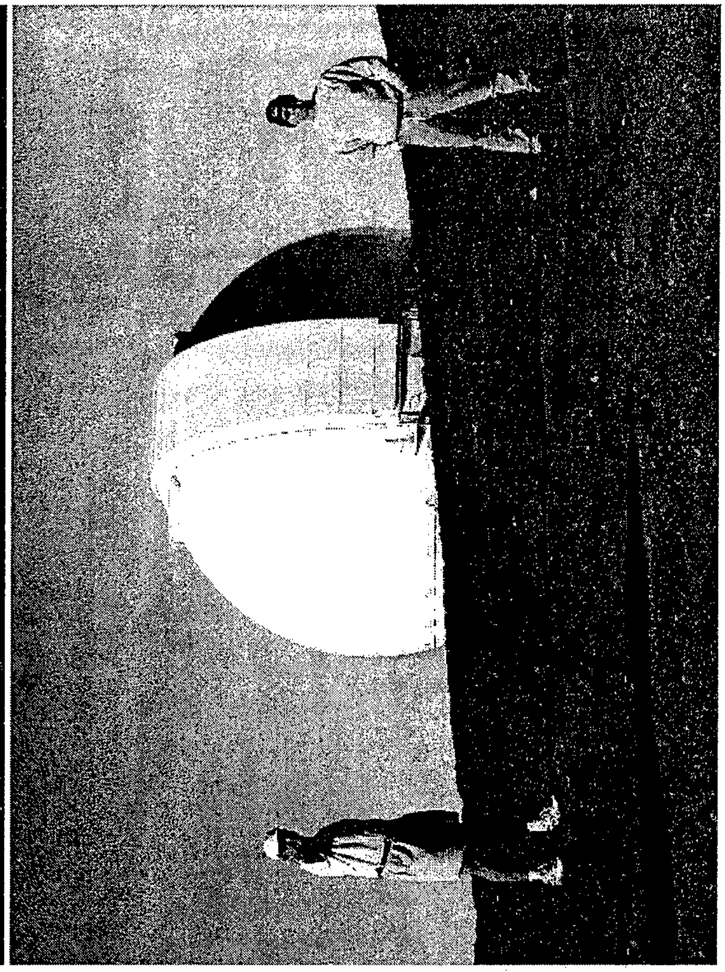
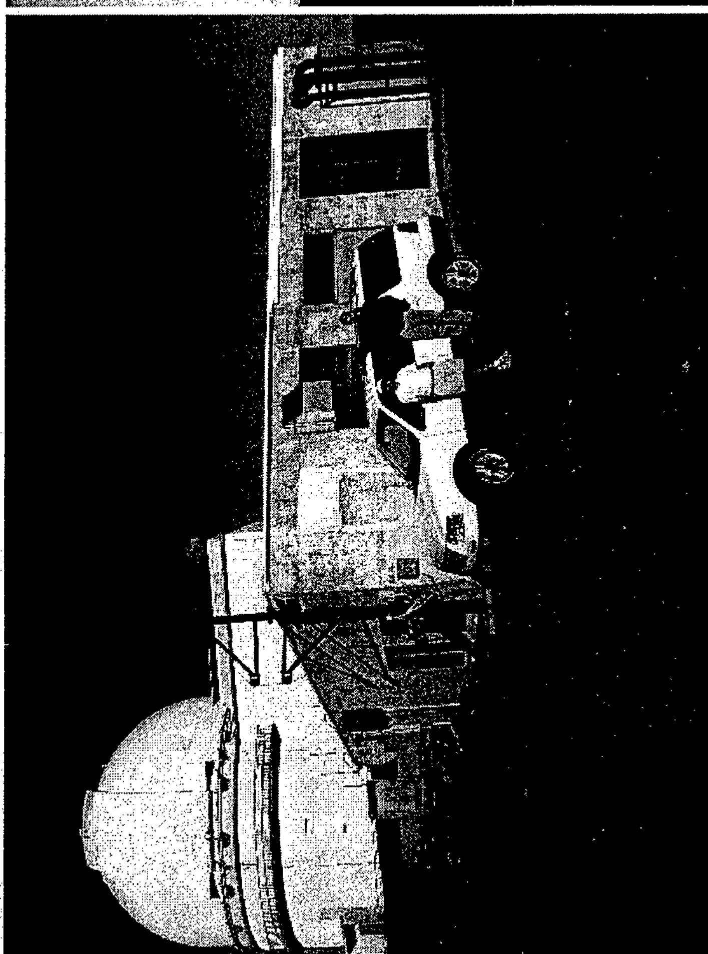
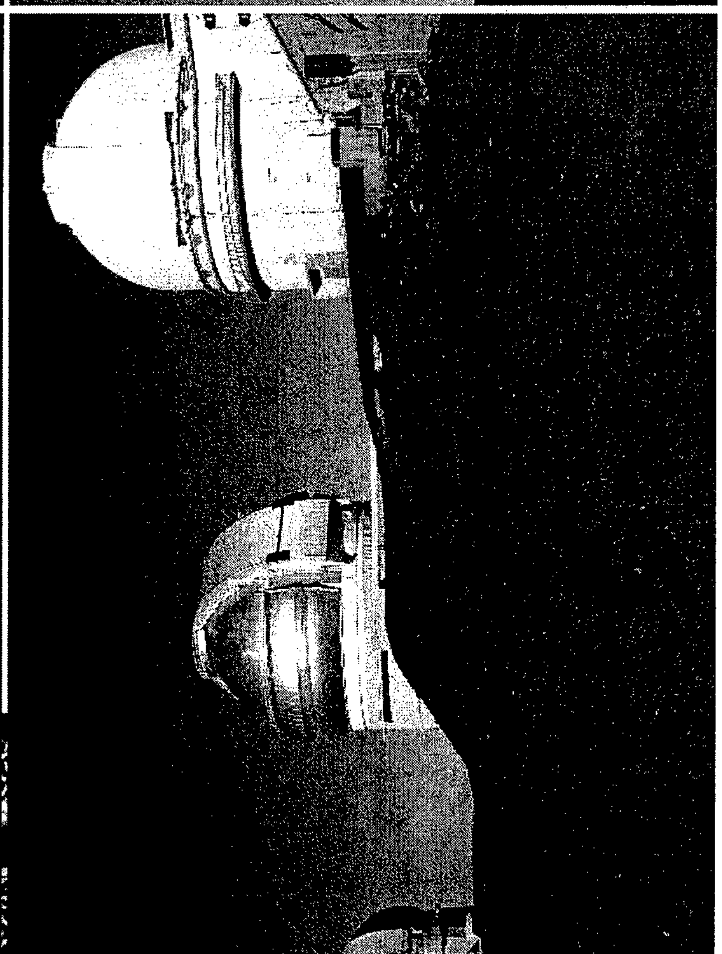
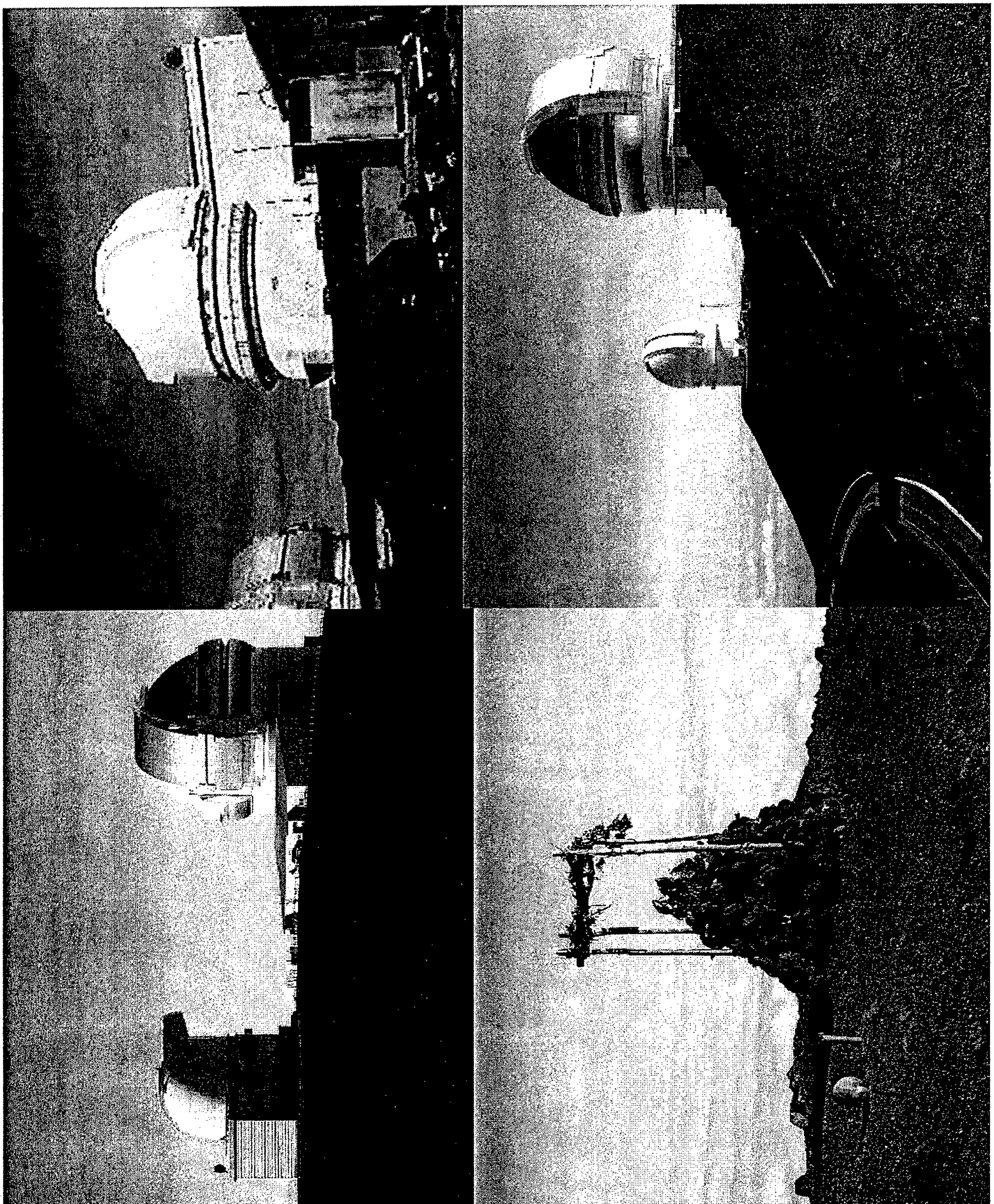
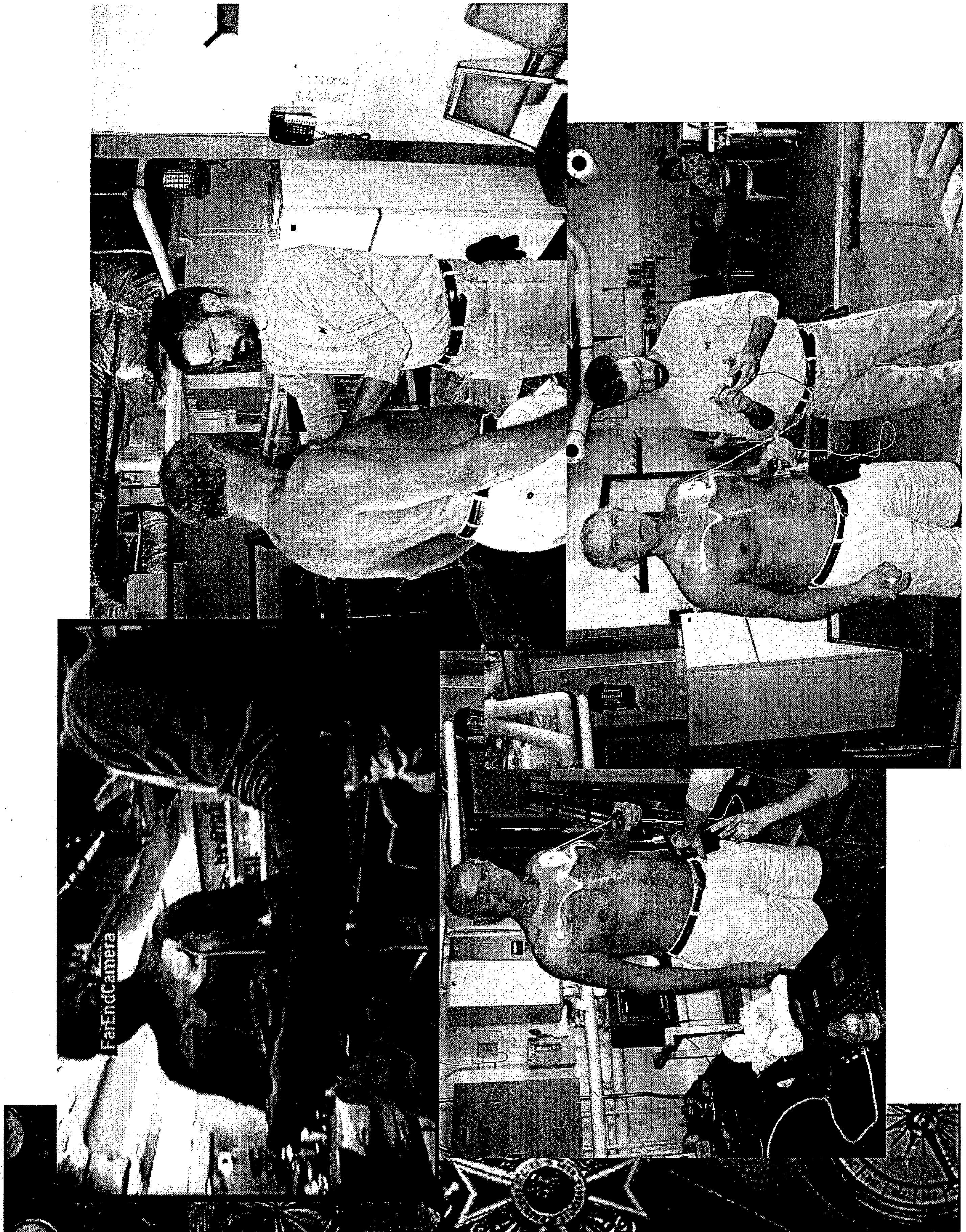
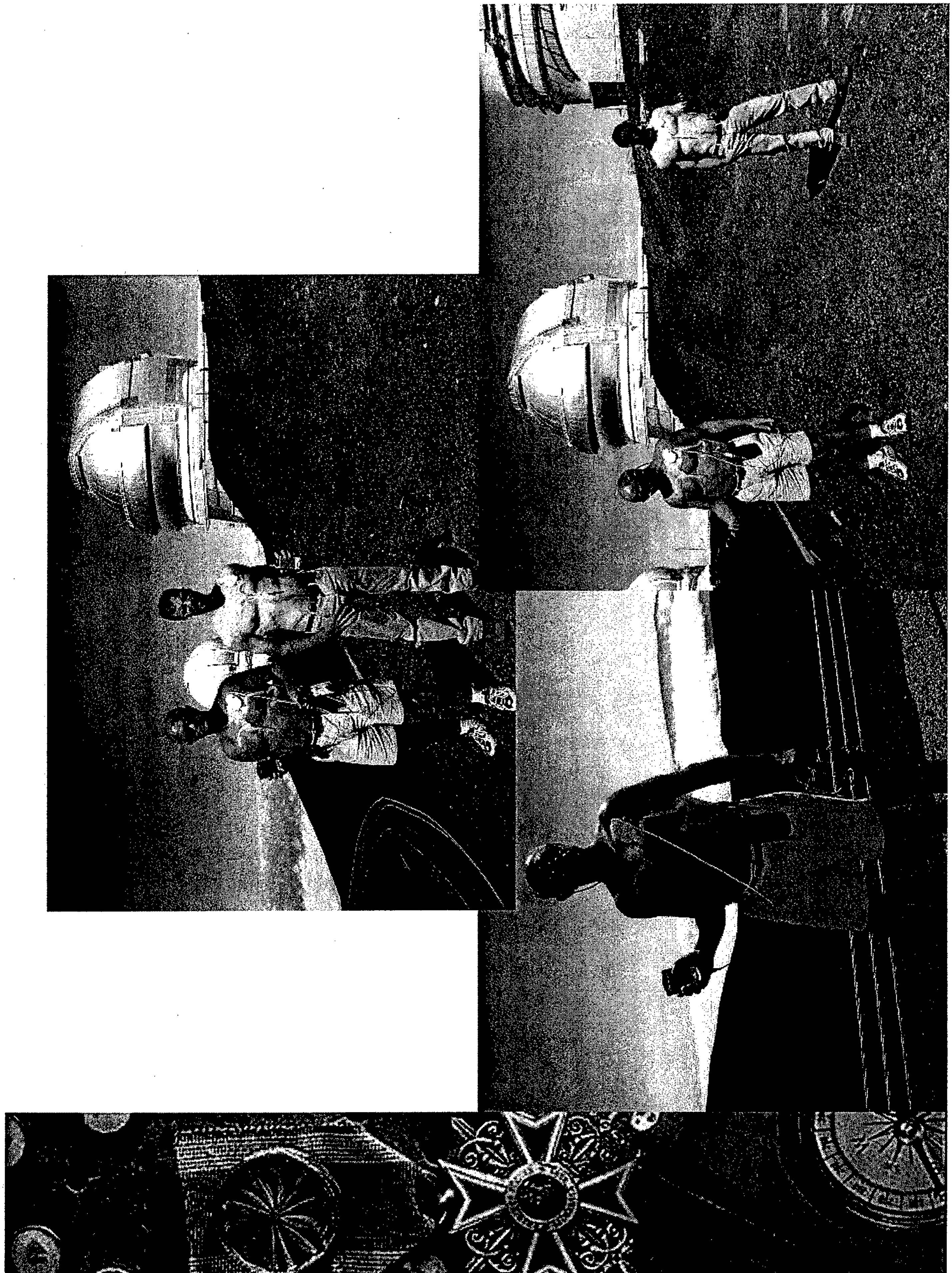




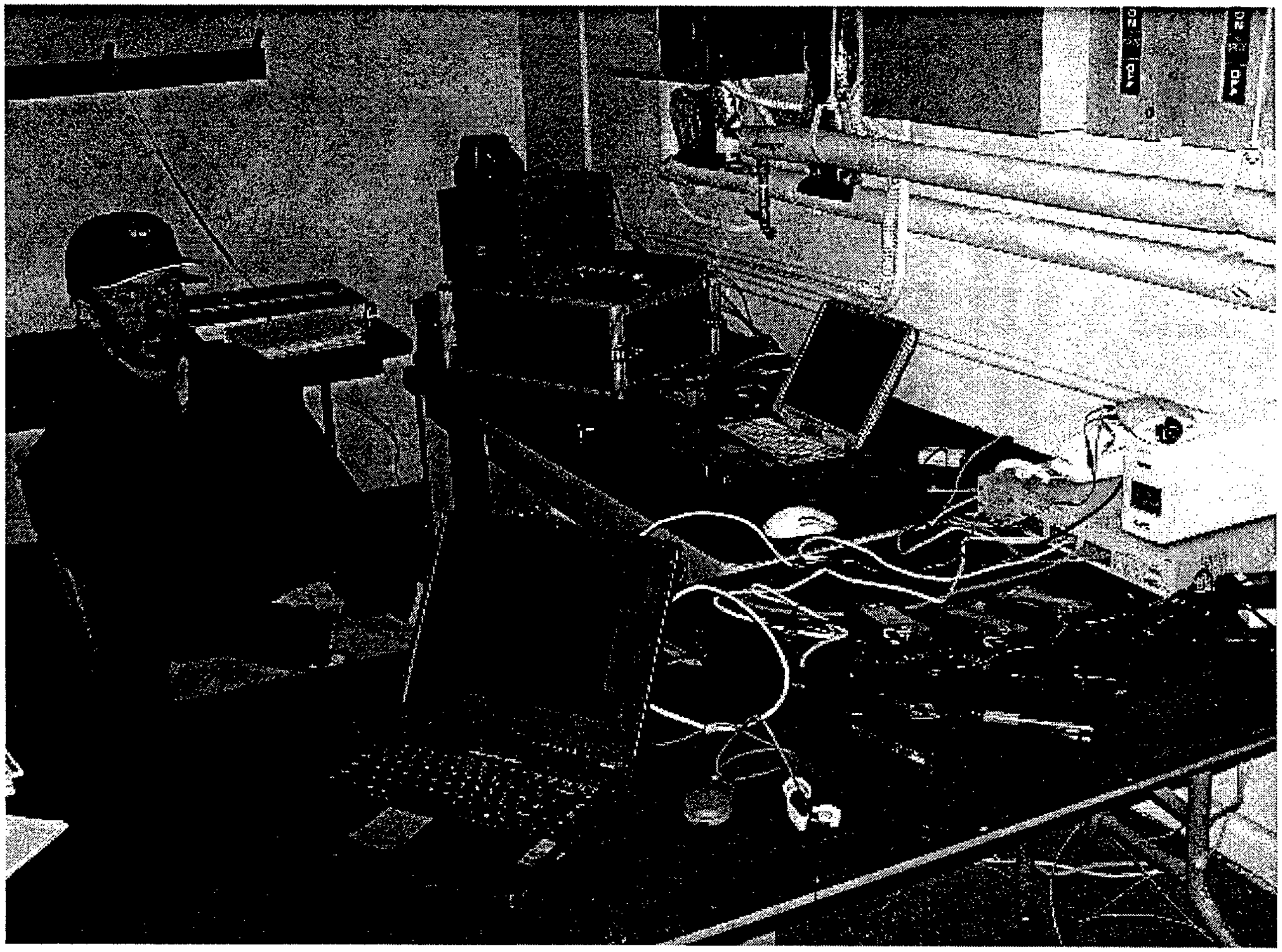




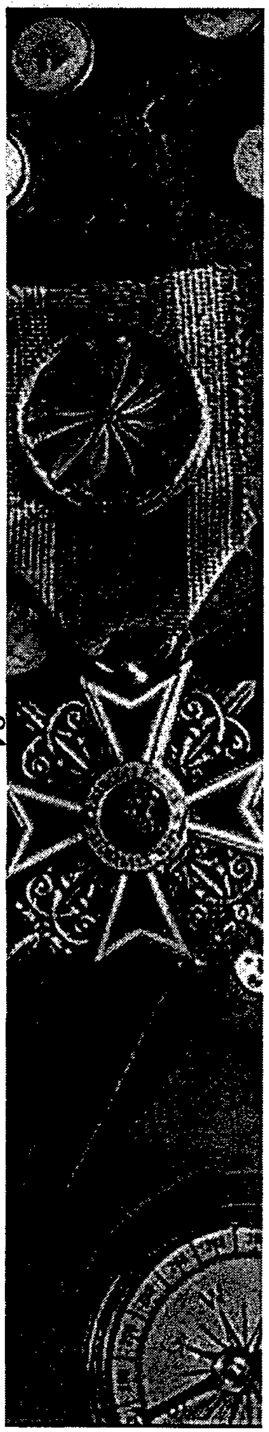

FarEndCamera



Summit: Equipment

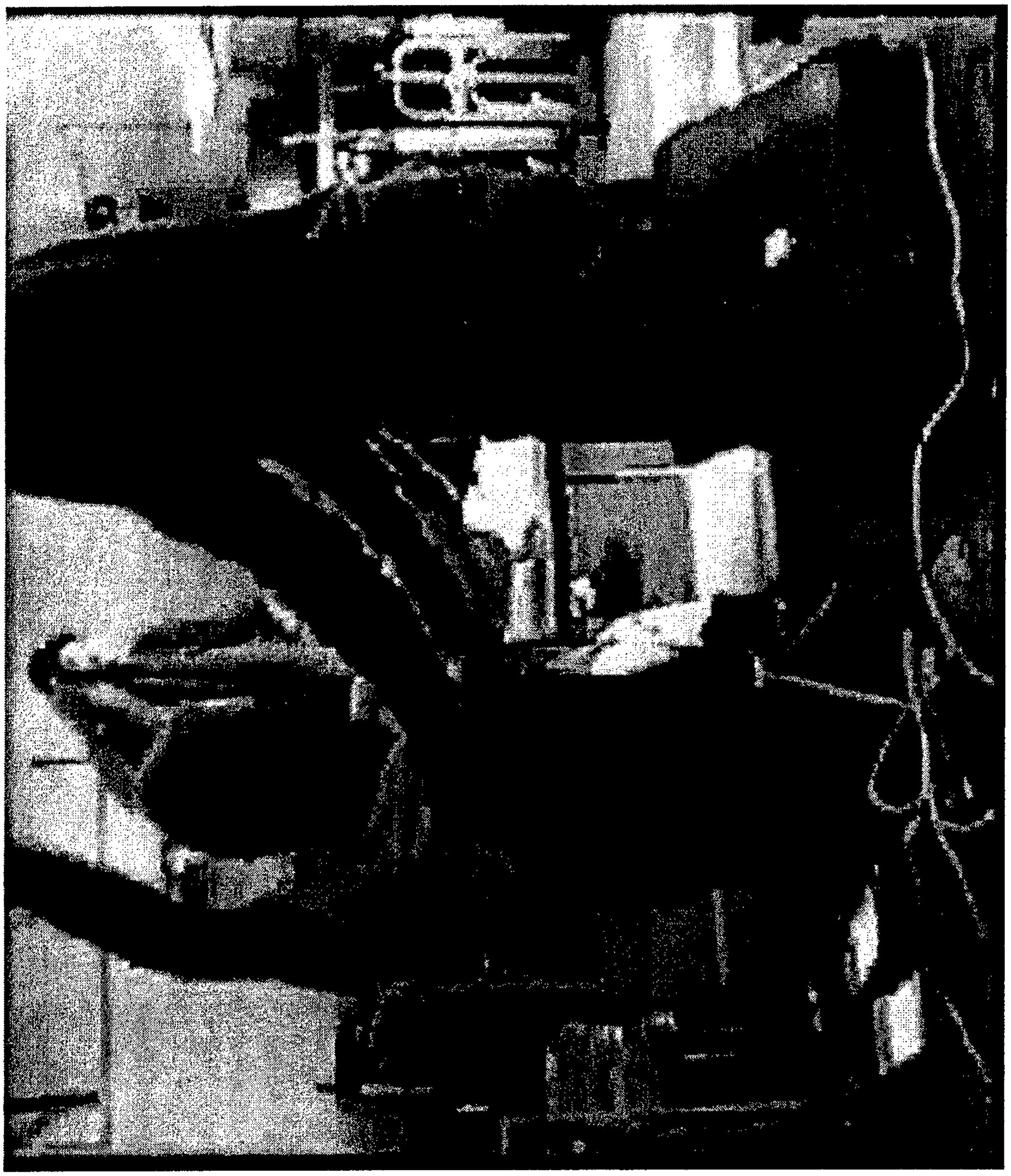


Deploying X-ray Unit



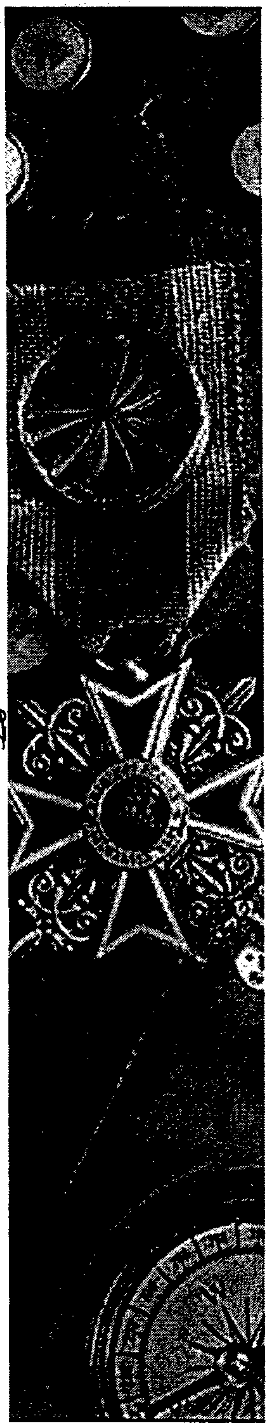
Day 2 - Saturday

- Janet, Pearl, and John ascend to base camp, John and Glenn (X-ray) go to summit
- More testing
  - Physiological logging and streaming (wired ether)
    - SpO2: Mark=83%, Guillaume=85%
    - Fast walk: Mark SpO2=75%, HR=124
    - Rest: return to normal SpO2 and HR
  - Xray unit deployed and tested
- John feels nausea, better in 30 seconds with O_2
- Guillaume and Mark tried to sleep outside at summit on first night, but too cold (20° F) and uncomfortable (altitude)
  - Sensors comfortable



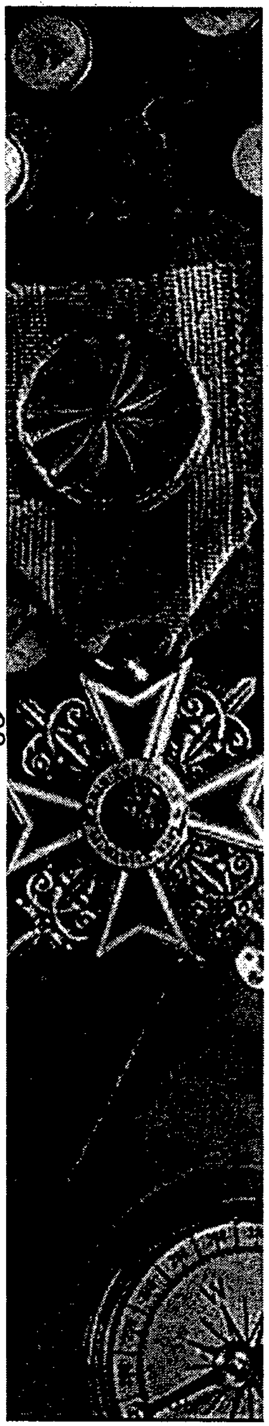
Third day- Sunday

- Janet, Pearl, and John ascended to summit with physiology & environmental logging every 1000 ft
  - Pearl SpO_2=75% at 13,000 ft
- More testing
  - Physiological logging and streaming (wired ether):
    - John SpO_2=85, HR=65 (120 while fast walking)
    - Pearl SpO_2=70, taken back to base camp
    - Pearl returns, SpO_2 goes to 56%, lips blue, O_2 given (1/3 l/m)
- Everyone goes to base camp for night



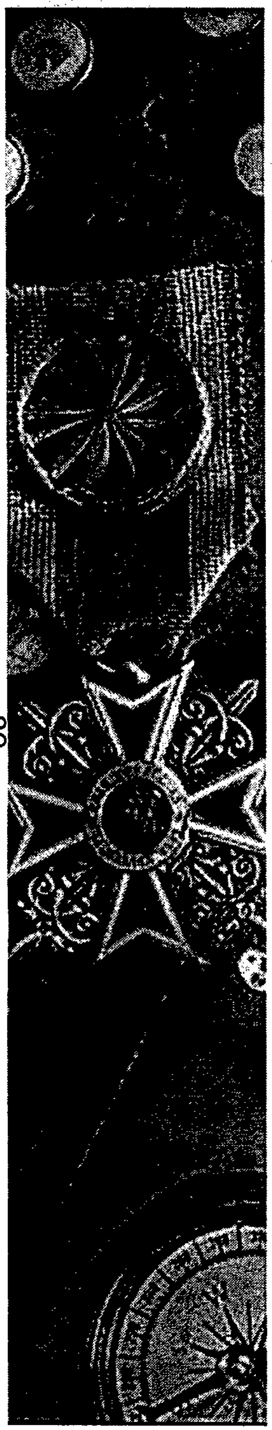
Hawaii High Altitude Research Center (HARC)

- Propose establishment of High Altitude Research Center (HARC)
- Evaluate how to prepare soldiers and others for rapid high altitude insertion
- Perform physiological monitoring and use as testbed for austere, remote environments (NASA and military needs)



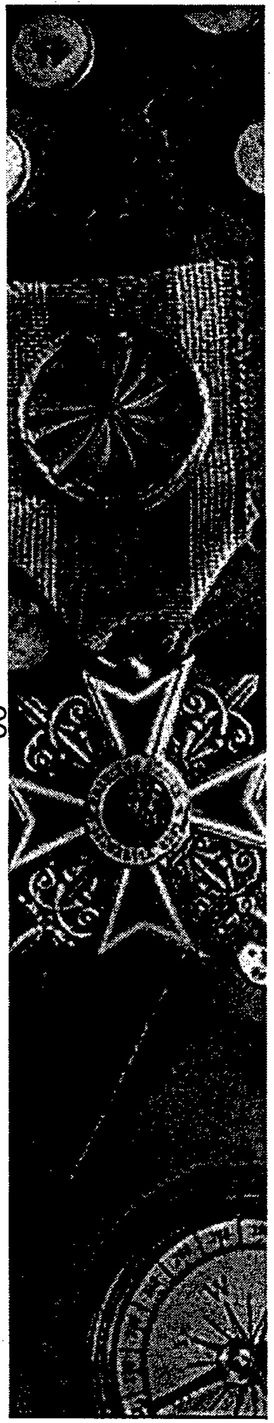
Hawaii High Altitude Research Center (HARC)

- Hawaii:
  - UH Office of Mauna Kea Management- Bill Stormont
    - Provides ultimate leadership/oversight
  - UH Chancellor's Office: Rose Tseng, PhD
    - Overall management and local research resources
  - Hilo Medical - Bill Lambeth, MD
    - Provides local medical care in emergencies
  - Sierra Club, Hawaiian Chapter - Nelson Ho
    - Ensures environmental and cultural protection
- Oahu:
  - UH Manoa - Telemedicine Project- Larry Burgess, MD
    - Telemedicine lead, clinical input
  - Pacific Telehealth & Technology Hui: Stan Saiki, MD
    - Joint DOD/VA, clinical input



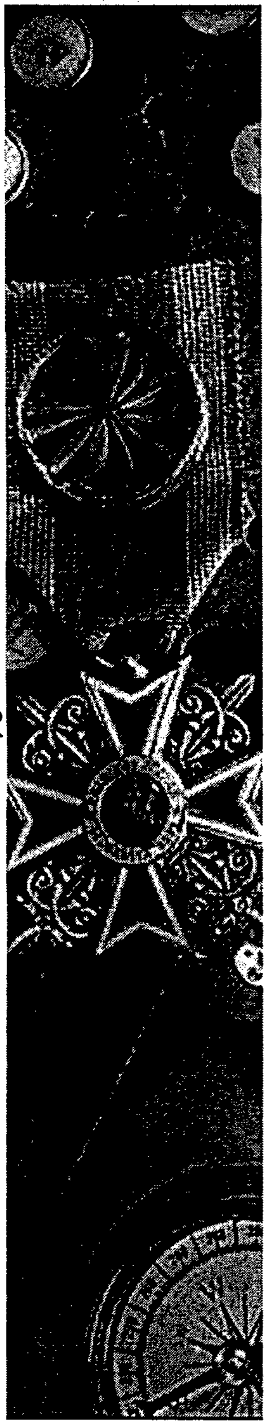
Hawaii High Altitude Research Center (HARC)

- Mainland:
  - Stanford University: Biocomputation Center- Kevin Montgomery, PhD
    - Telemedicine technologies, clinical research support
  - Natick Soldier Center (Boston): Reed Hoyt, PhD, Henry Girolamo, PhD
    - Collaborate on soldier physiological monitoring in harsh environments
  - TATRC (Maryland): Rufus Sessions, PhD
    - Collaborate on deployable wireless telemedicine
  - NASA:
    - Ames Research Center (California): Astrobionics – John Hines
      - Collaborate on biosensors, biotelemetry
    - Johnson Space Center (Houston): Medical Operations - James Logan, MD
      - Collaborate on medical operations in austere environments



Lessons Learned

- Physiological indicators:
  - SpO_2 appears to be key indicator
  - Other physiological changes occurred
    - With mild exercise heart rate and respiration rate increased significantly
- Biosensors: Hardware/software issues identified and have been or will be corrected
- Heavy equipment deployment doesn't work well at altitude



Summary

- System worked, but refinement desired
- High altitude testbed appears feasible

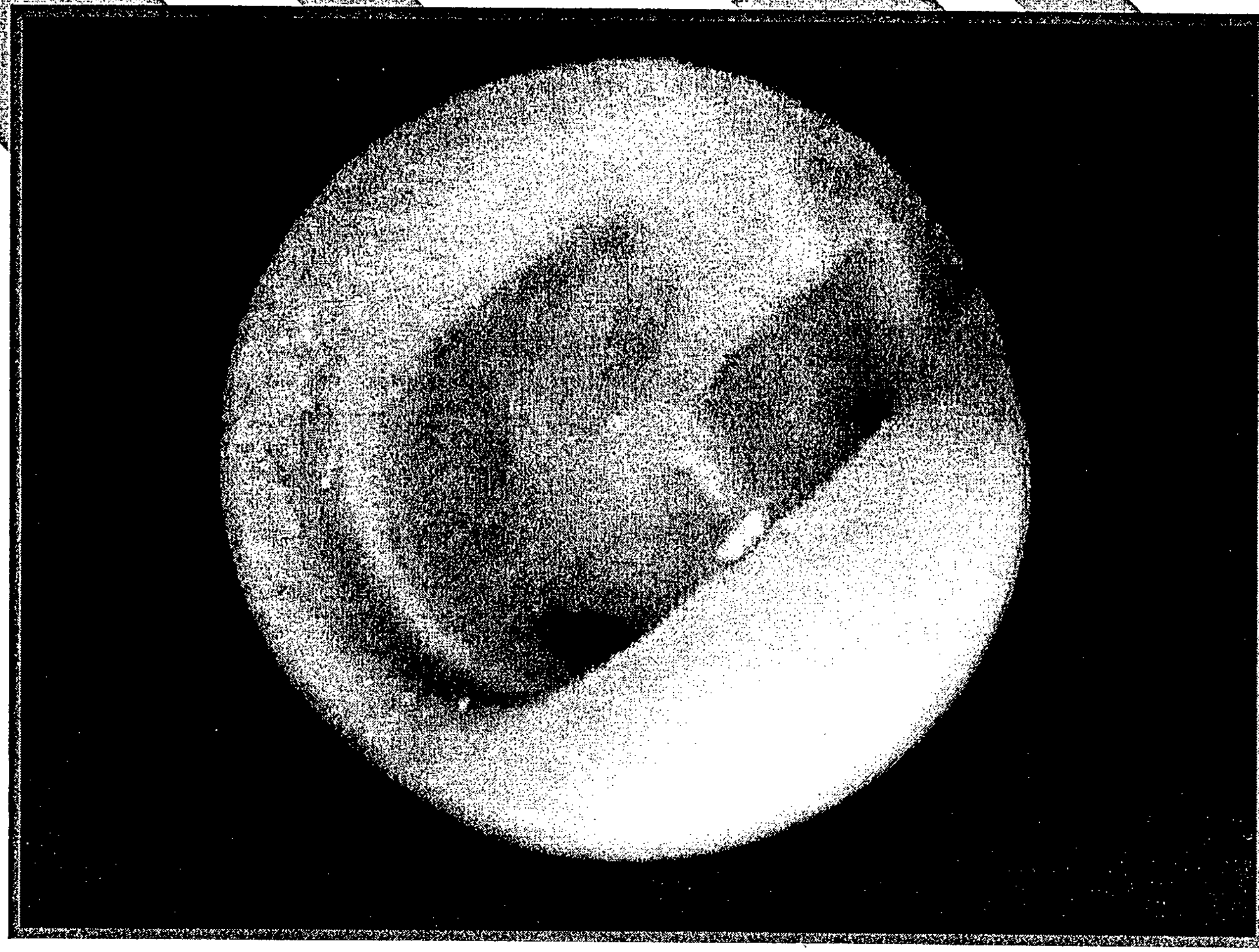
Telemedicine Research and Evaluation

Deborah P. Birkmire-Peters, Ph.D.
UH Telemedicine Project
John A. Burns School of Medicine
University of Hawaii

November 18, 2002

Video-Otoscopy

Video Image of Middle Ear



Statement of the Problem

- All active-duty military and DoD civilians in certain occupations receive a yearly hearing screening.
  - If there is a significant threshold shift, the patient is required to have an otological examination to rule out pathology.
  - In practice, compliance with this follow-up examination is extremely low.
- Otitis media frequently misdiagnosed.

Proposed Solution

- Capture the digital video images of the outer ear at the time of the hearing screening or appointment with primary care provider.

- Forward images electronically along with other pertinent data to medical specialists for triage or screening.

Research Objectives

- Establish the efficacy of video-otoscopy for electronic triage.
- Collect data from remote sites to establish clinical protocols.
- Determine methods to increase the accuracy of video-otoscopy over current methods of practice.

Study Design

- One-hundred ears were examined by board certified otolaryngologists with a hand-held otoscope followed by binocular microscopy.
- The ears were rated for both exams on predetermined physical characteristics utilizing 5-point Likert scales.
- Binocular microscopy is currently considered the gold standard in otolaryngology.
- Audiometric data were collected at the time of the physical examination.
- Video images of ears were recorded at the time of the physical examination.

Study Design

- Three months or more following the patient examination, the video images were rated on the same 5-point Likert scale.
- Four otolaryngologists independently rated each image.
- Images were stored as JPEG files and viewed on Power Point™ without patient history.

Conclusions

- Initial analyses of correspondence between physical examinations and evaluations of video images showed moderate agreement.
- Agreement on images of normals was in the substantial range.
- Research needs to be done to determine what other information, i.e. case history and audiometric data, is needed for accurate triage.

Teleproctored Surgery

Statement of the Problem

- Remotely based healthcare providers often lack expertise in all surgical specialties.
- Urgent/emergent surgical care may be less than optimal.
- Chronic/subacute care results in costly evacuations.
- Evacuation not always possible: indigent populations and emergency situations.

Proposed Solution

Projection of specialty and sub-specialty expertise into remote locations through telecommuncations technologies.

Research Objectives

- Collect a large empirical database to support the widespread adoption of teleproctored surgery.

- Establish the safety, effectiveness, feasibility, and generalizability of teleproctored surgery.

Research Plan

- Establish the proof-of-concept through in-house testing of procedures and protocols using as models the following surgical procedures:
  - Functional endoscopic sinus surgery (FES).
  - Basic and advanced laparoscopic surgeries.
- Determine the technical specifications of hardware to support the clinical application.
- Develop training procedures for conducting these types of surgeries.

Study Design

- Controls: Proctored conventionally with attending surgeon in OR.
- Experimental: Proctored using AV teleconferencing with attending surgeon in control room 15 seconds from OR.

Data Collection

- N = 130 FES cases
- Cases rated on:
  - Disease classification
  - Clinical outcomes
  - Procedures

Results

- No differences between teleproctored and control in disease classification measures or clinical outcomes.
- Teleproctored cases required more time than conventional cases, but the time differences were not clinically significant.

Conclusions

- Teleproctored FES appears to be a safe and effective method of mentoring.
- Teleproctored surgery allows increased independence during training of surgical residents.

Remote Voice Therapy

Statement of the Problem

- Speech pathology services for active duty personnel and their family members are limited or non-existent in the Pacific Basin.
- Currently, patients are sent to Tripler for services.
- Services are less than optimal due to time constraints and limited follow-up.

Proposed Solution

- Delivery of rehabilitative speech therapy services remotely using telecommunications technologies.
- Benefits include:
  - Improved therapy outcomes, particularly those that require intensive, long-term rehabilitative follow-up
  - Avoidance of surgery
  - Reduced travel costs and less time away from job and family
  - Potential for in-home delivery of services

Research Objectives

- To establish the feasibility and efficacy of remote voice therapy.
- To establish the hardware/software specifications for delivery of speech therapy services.
- To determine which speech therapy services are candidates for remote delivery.

Research Plan

- Establish the proof-of-concept through a comparative study evaluating treatment outcomes for voice therapy delivered conventionally and remotely through hard-wired audio-video link.
- Collect treatment outcomes data for delivery of voice therapy to remote locations.
- Determine technical specifications for hardware/software to support the delivery of rehabilitative services.

Data Collection

- Perceptual judgments of voice quality
- Acoustic analyses
- Fiberoptic laryngoscopy
- Patient satisfaction

Study Design

- N = 72
- Four etiologies:
  - Vocal nodules
  - Edema
  - Unilateral vocal fold paralysis
  - Vocal hyperfunction with no laryngeal pathology
- Therapy delivered conventionally, i.e. face-to-face, or via VTC link with therapist in separate room.

Results

- No differences between the conventional and telehealth groups in clinical outcomes.
- Significant differences between pre- and post-treatment measures of clinical outcomes.
- Patient satisfaction in telehealth group extremely high.

Conclusions

- Delivery of rehabilitative voice therapy from a distance appears to be effective and a positive experience for the patient.
- Research needs to determine technical specifications and optimal clinical workflow.

Joslin Vision Network

Statement of the Problem

- Diabetes is a leading cause of adult blindness.
- 50% of Americans with diabetes remain undiagnosed.
- 40% of diabetic patients requiring laser surgery for diabetic retinopathy do not receive treatment.

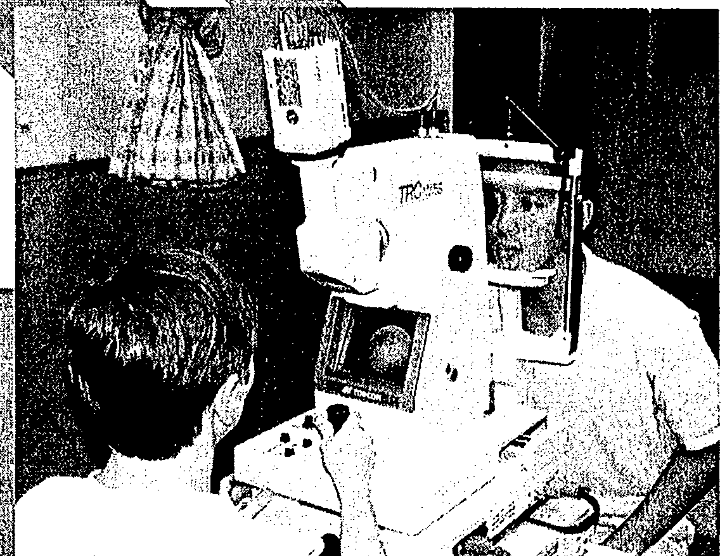
Statement of the Problem

- Primary care providers are not effective in diagnosing diabetic retinopathy.
- Specialty staff is inadequate to screen all diabetic patients at risk.
- In remote settings, specialty screening is often unavailable.
- Specialty effort is diverted from laser treatment to routine diagnosis.

Proposed Solution

Remote access of patients with diabetes into an annual eye exam program with diagnosis of diabetic retinopathy levels at centralized subspecialty centers using digitized video images of the retina.

Joslin JVN Image Capture Station

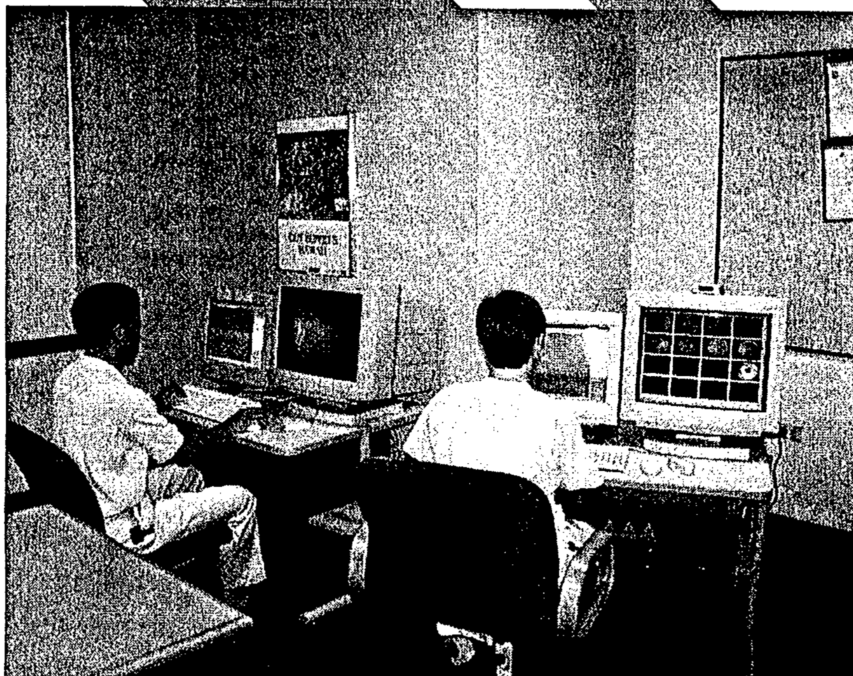


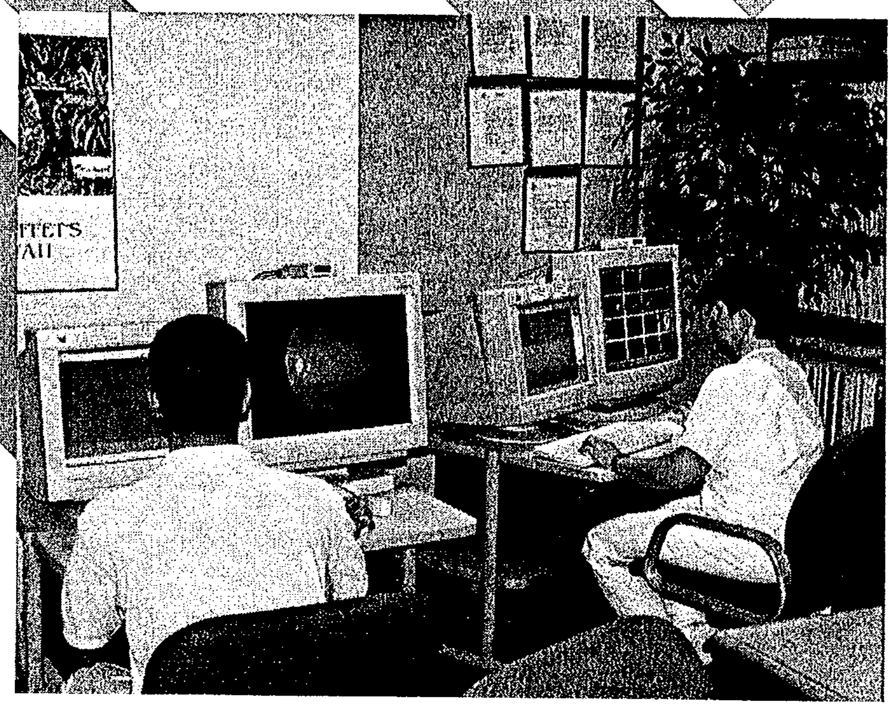
Images are taken without having to dilate the pupils.

6 images of the retina are taken in stereo (3D); with one external image of each eye.

Joslin JVN Image Review Station

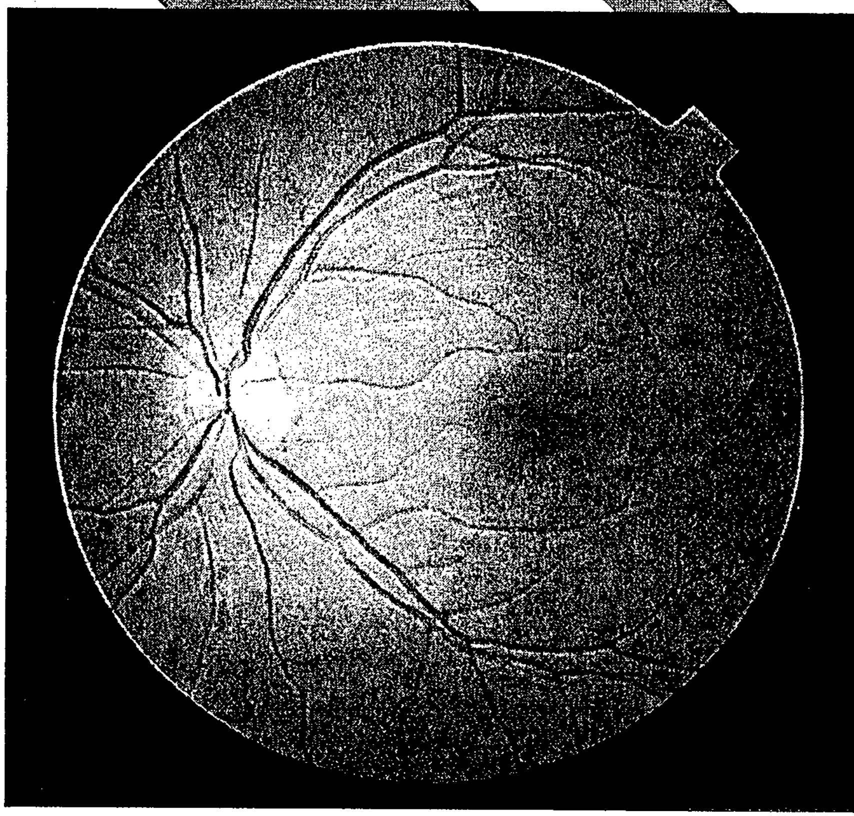
After images are taken, they are labeled and stored in a central server.

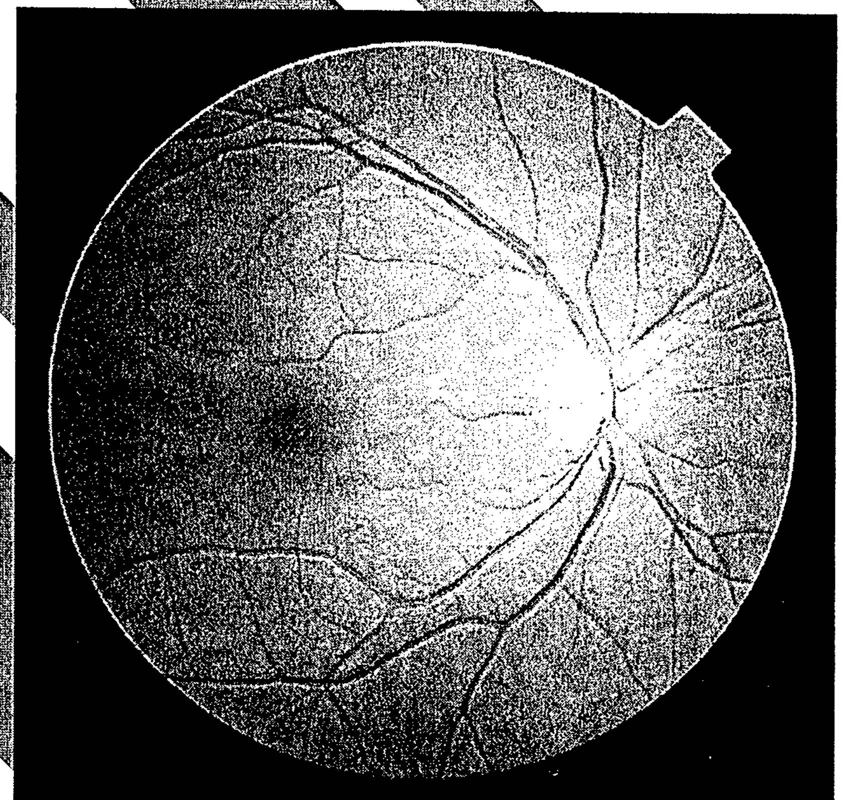




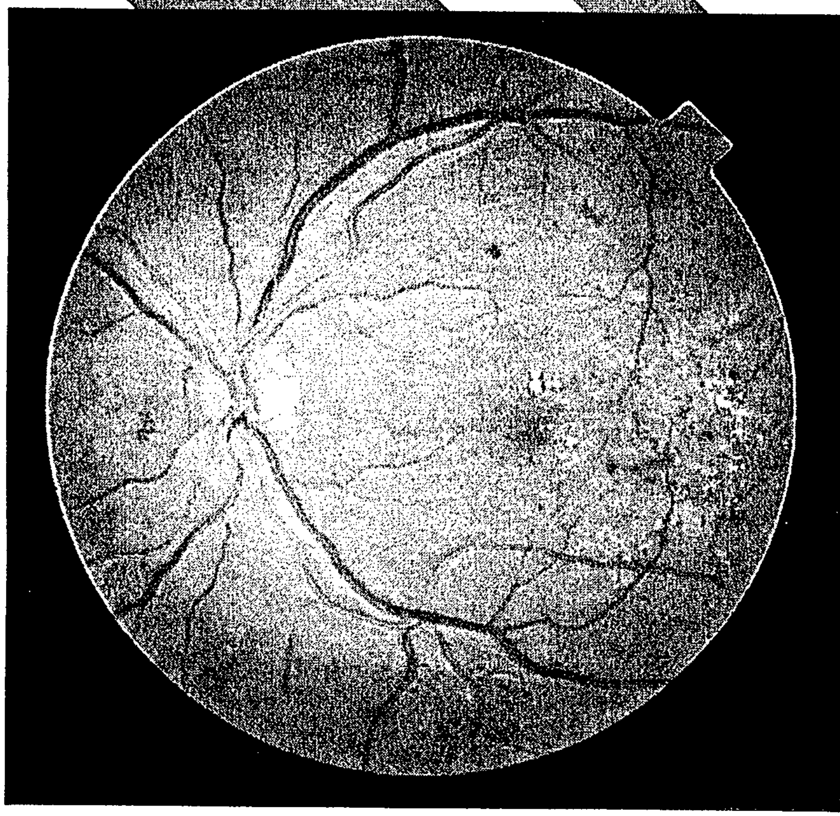
Physicians can access patient images through the reading workstations, shown in these two pictures.

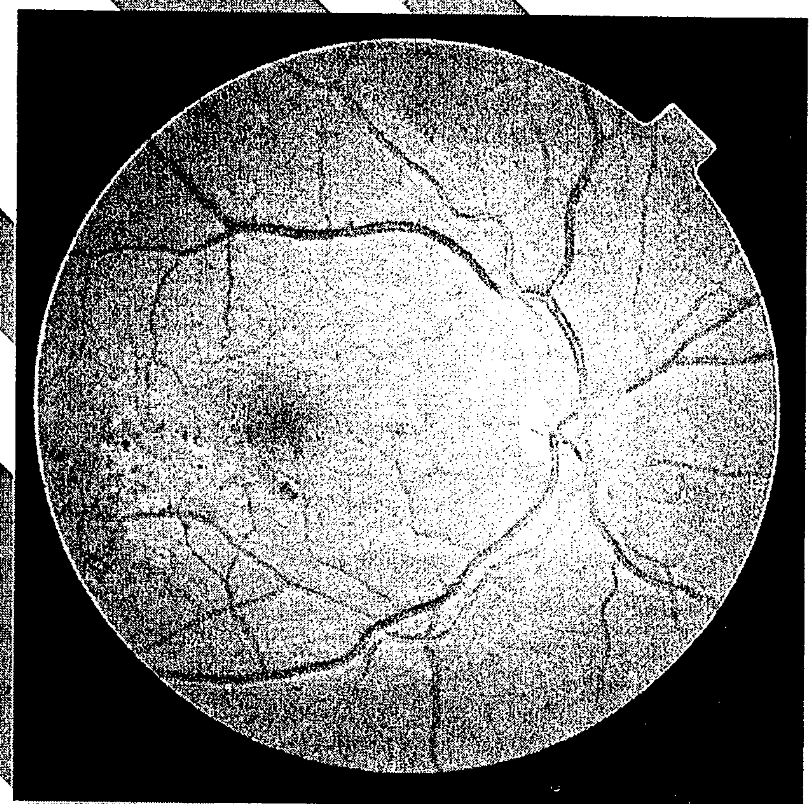
Healthy Retina



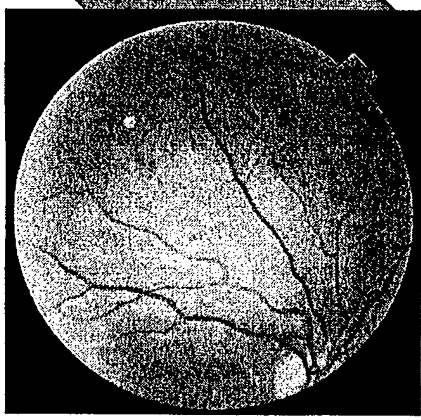
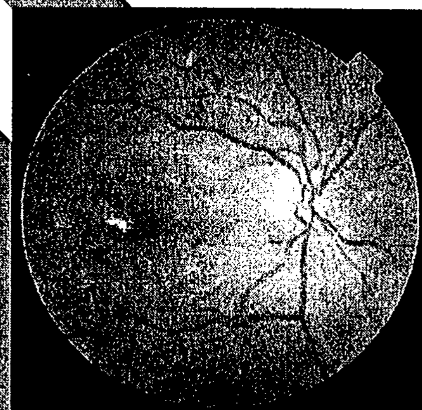
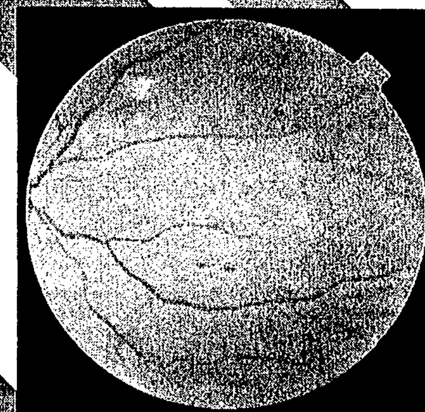


Proliferative Diabetic Retinopathy and Clinically Significant Macular Edema





Multiple Fields

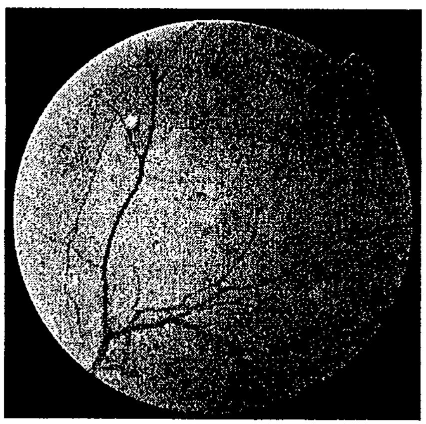
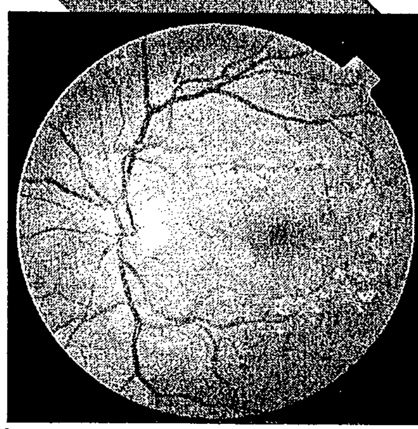
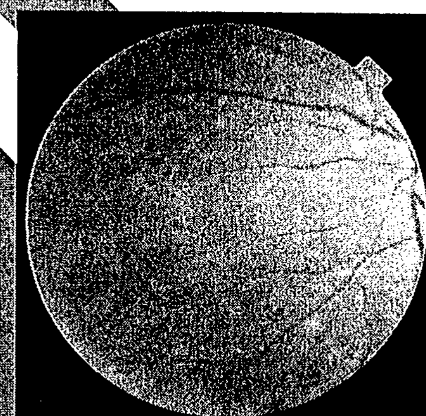




Right Eye

Superior temporal to optic disc

Central between optic disc and macula

Nasal to optic disc

Left Eye

Sets of non-mydriatic stereoscopic fundus images are taken.

Three photographic fields are identified above.

Research Objectives

- To validate of the Joslin technology that uses a low light level video camera for the acquisition of non-mydriatic retinal fundus images for the evaluation of diabetic retinopathy.
- To determine if patient access to specialty and subspecialty providers is improved with the use of this technology.

Research Plan

- Establish the validity of the JVN technology by comparing assessment of level of diabetic retinopathy with 35mm photographs to digital non-mydriatic retinal fundus images captured with the low light camera.
- Determine if patient access to specialty and subspecialty providers is improved.
- Determine the feasibility of real-time assessments of level of diabetic retinopathy.

Study Plans

- Validation of digital images acquired with low light level video camera.
- Comparison of assessment of level of diabetic retinopathy from dilated eye examination to JVN images.
- Demonstration of real-time assessments of level of diabetic retinopathy.
- Deploy retinal imaging system to remote locations.

Results

- Substantial agreement between diagnosis of diabetic retinopathy from 35mm photographs to JVN digital images.
- Approximately half of scheduled diabetic patients were assessed for level of diabetic retinopathy by a remote specialist in real-time.
- Increase access to eye care for patients located remotely.

Conclusions

- Diagnosis of diabetic retinopathy using the JVN system is as effective as the current gold standard.
- Real-time assessment of level of diabetic retinopathy is not practical.
- Appears that patient access is improved when the JVN system is deployed to remote locations.

University of Hawaii Telemedicine Curriculum
Meeting and Product Line Review (PLR) Presentation
Learnframe Demo
12 December 2002
0900-1200

Attendees	Affiliation
Dr. Deborah Birkmire-Peters	University of Hawaii
Mr. Alan Brown	Learnframe, Inc.
COL Dean Calcagni	TATRC
Mr. Conrad Clyburn	TATRC
Mr. Steven Heard	NoVa Technology Partners (also TATRC Commercialization Consultant)
Ms. Jessica Kenyon	TATRC
Mr. Harvey Magee	TATRC
Mr. Ralph Mason	Learnframe, Inc.
Mr. Daimen Michaels	TATRC
Mr. Jim Olson	TATRC
Dr. Rufus Sessions	TATRC
Mr. John Winston	TATRC

Minutes

- Welcome and Introductions: Dr. Sessions, GOR for the University of Hawaii Cooperative Agreement
    - Dr. Birkmire-Peters was originally scheduled to present the progress of the University of Hawaii (UH) Telemedicine Curriculum Project at the Distance Learning Product Line Review (PLR) that was to take place on the 12th of December. The PLR was subsequently postponed, but by the time it was postponed, Dr. Birkmire-Peters had already made unalterable travel arrangements.
    - Because it is unlikely that Dr. Birkmire-Peters will be able to return for the rescheduled Distance Learning PLR, the presentation at this meeting constitutes a special PLR presentation.
    - In addition, the agenda included a presentation and demonstration by Mr. Ralph Mason and Mr. Alan Brown of Learnframe, who have been working with the University of Hawaii to make their Telemedicine Curriculum compliant with the Sharable Content Object Reference Model (SCORM) standard.

- Introductory Comments on UH Project: Dr. Sessions
    - Now in its final year, the project was funded via a cooperative agreement for four years of work.
    - The project initially received two-year funding in FY98.
    - Initial funding covered the period FY98 through FY00. Additional money was appropriated by Congress, resulting in an additional two years of funding beginning in FY01. The end of the Period of Performance for the project is July 2003.

- When the project first began, the Principal Investigator (PI) was Dr. John Hardiman, who was later replaced by Dr. Richard Friedman. In January 2002, Dr. Larry Burgess replaced Dr. Friedman.
- Dr. Birkmire-Peters joined as Project Manager on a part-time basis in April 2002, and has been involved full-time since October.
- The development of the Telemedicine Curriculum was to be informed by the recommendations of a National Advisory Committee, made up of a number of DoD subject-matter experts. The first meeting of the Committee was held at the 2000 meeting of the American Telemedicine Association (ATA) in Phoenix. The group convened a second time in November 2001.

- PLR Presentation by Dr. Birkmire-Peters (see also accompanying PowerPoint slides)
  - Dr. Birkmire-Peters began by pointing out that she is relatively new to the project, and because of the 100% turnover in personnel over the course of the project, the sense of "corporate history" is somewhat lacking.
  - UH is currently in the process of making changes to the curriculum, though these are not yet visible on the web version.
    - The title page is being changed to a login page
    - A new table of contents page, which includes the titles of the four new modules, has also been developed.
  - UH is working with Tripler Army Medical Center to obtain subjects for a formal evaluation of the curriculum.
  - UH has also worked with the AMEDD Center & School about the possibility of incorporating the curriculum into their web site.
    - Dr. Sessions commented that at the 2000 meeting of the National Advisory Committee, COL Harrison Hassell of the AMEDD C&S became very enthusiastic about the curriculum and suggested its inclusion into AMEDD C&S online programs.
    - In 2001, the UH gave a copy of the curriculum to AMEDD C&S, and they were going to investigate how to incorporate it into their existing online curriculum. It was to be used immediately as adjunct reading material, but has not, as yet, been put on the web site.
    - Dr. Burgess has been in communication with COL Tefft, a successor of COL Hassell, about how to deliver UH's curriculum at the school, but some technical barriers have been discovered. These are now being worked on.
    - Ideally, the AMEDD C&S will have the UH curriculum up and running before the end of project funding in July 2003.
    - COL Calcagni expressed his concern that the bureaucracy at the AMEDD C&S will slow down the process of integrating the UH curriculum, and he is pessimistic that it will ever be accomplished.
      - UH will be willing to host the curriculum, even if integration with AMEDD C&S ultimately fails.
    - USUHS, though it initially expressed an interest in the project, has elected not to get involved in delivering it.

                - Dr. Sessions also mentioned that he now has a good working relationship with Dr. Leon Moore at USUHS, and that he could potentially be helpful.
                - Mr. Clyburn mentioned a recent conversation with Admiral Zimbal of USUHS, who was very interested in an MOA between TATRC and USUHS. Mr. Clyburn plans to have further discussions with Admiral Zimbal in the near future, and will raise the issue of the UH Curriculum.
        - As a last resort, TATRC could host the curriculum long-term.
        - Dr. Birkmire-Peters mentioned that Dr. Stan Saiki, with whom they are in close coordination, may be a good advocate for placing the curriculum in the VA system.
    - UH does not currently have any plans to market the curriculum commercially.
    - Mr. Clyburn asked if the UH has considered partnering with one of the Boards (such as the American Board of Family Practitioners) to, perhaps, leverage what has been done as part of the physician certification process.
        - Dr. Sessions agreed to pursue this as an action item.
    - Projected Outcomes
        - A formal evaluation is, in which subjects will read the curriculum on their own time via the web interface, is in its final planning stages. Participants will then take tests on the material covered and answer a variety of questions about the curriculum. Subjects will have two months to complete the curriculum and evaluate it.
            - The evaluation will also include a short in-person component, in which subjects who have evaluated the curriculum will be interviewed on how they have been able to apply what they learned.
        - UH is exploring the possibility of offering Continuing Medical Education (CME) credits for those who complete the curriculum. CME online would represent substantial cost and time savings over conventional CME programs.
        - The curriculum is now being used at Howard University.
    - Challenges
        - The greatest challenge to date has been getting subjects for the evaluation of the first six modules. The desired subject population was not easily accessible.
        - The time investment required to complete the evaluation, about 8 to 10 hours per participant, is significant.
        - UH anticipates about 40 subjects, but not all of them will come from Tripler. It will probably be necessary for the UH to recruit some civilian subjects as well.
    - After the conclusion of the presentation, Dr. Sessions mentioned that each quarterly report, from now on, would ideally include a cumulative list of project-related publications and presentations.
        - Dr. Sessions stated that he would also appreciate early e-mail notifications of any project-related presentations.
- Learnframe Demo

- Mr. Mason reported that Learnframe has analyzed UH's curriculum and will demonstrate the appearance of the curriculum both before and after the SCORM "wrapper" was applied.
    - Learnframe received a CD-ROM copy of the UH curriculum then, after some technical discussions with UH, proceeded with a technical analysis before applying their SCORM wrapper.
- Dr. Birkmire-Peters asked if there is a way of generating SCORM-compliant content objects from the outset. Mr. Mason replied that Learnframe has an authoring tool that can do this.
- Learnframe has developed "Magic Sauce," a connection tool that allows them to put their SCORM wrapper around any content
- Applying the SCORM wrapper to the University of Hawaii curriculum took a relatively short period of time, with the aid of Magic Sauce.
- For this demonstration, Learnframe made the entire curriculum a single SCORM object, but it could be broken down into multiple objects. Mr. Clyburn suggested that breaking the curriculum down to the task level might be most practical.
- In general, streaming video and other multimedia works within the SCORM wrapper. Any features that worked before the wrapper was applied should also work afterwards.

- Remarks and Project Discussions
    - New Modules
        - From the government perspective, the new modules should cover advanced topics in telemedicine
        - The upcoming module for the first responder will be directed specifically at the combat medic (91W), rather than any other category of medical technician.
        - Dr. Sessions pointed out that there is no set-in-stone agreement on what the four new modules should be, and that this discussion needs to be finalized.
        - Mr. Clyburn mentioned that Dr. Bob Foster, Director of BioSystems, Office of the Director of Defense Research and Engineering, Office of the Secretary of Defense, is interested in a training instrument for the First Responder that would include pieces on bioterrorism and other topics. He is primarily interested not in content that is associated with a single institution, but in the overall architecture of Advanced Distributed Learning (ADL) under the SCORM standard. More specifically, he is interested in modules that can be separated and used by anyone in the DoD.
            - Mr. Clyburn said that there is a background request from senior leadership within the DoD to figure out how to contribute to the ADL architecture for the First Responder. The University of Hawaii curriculum may be part of the answer, but other possibilities include the CDC, Drexel University, the DREAMS project, and others, but their content is not yet SCORM compliant.

- Dr. Sessions mentioned the 2000 Internet2Learn Summit, and provided a link to the presentations given at the meeting, including those pertaining to the ADL Co-Labs and SCORM (http://www.tatrc.org/website_i2l/i2l_2000/index.html).
- Mr. Clyburn said that it would now be useful to test the newly SCORM-compliant University of Hawaii curriculum to ensure the robustness of the wrapper. This might be done collaboratively with the ADL Co-Lab.
- Mr. Mason stated that it is generally possible to make revisions to content after the SCORM wrapper has been applied, and the wrapper itself will remain unaffected. However, it is possible for certain high-level changes to affect the wrapper.

- Afternoon post-meeting discussions
  - Dr. Birkmire-Peters met briefly with Dr. Jaques Reifman to discuss the possibility of using his expertise in devising an informatics/databasing module
  - In a meeting with Dr. Sessions and Ms. Kenyon, Dr. Birkmire-Peters stated that she was pleased to learn that a means exists to make legacy distance learning content SCORM compliant. However, she also mentioned that the Hawaii technical person, Mike von Platen, requested a cost breakdown from Learnframe, but had yet to get a response.
    - Dr. Sessions agreed to take it as an action item to pursue the status of the Learnframe demo and whether the University will have to pay for Learnframe's SCORM wrapper.
    - Dr. Birkmire-Peters agreed to pass on Learnframe's quote once she receives it.

- Summary of Action Items
  - Continue efforts to get the Hawaii curriculum on the AMEDD C&S web page
  - Give further consideration to the suggestion by Mr. Clyburn that the University of Hawaii partner with, for example, the American Board of Family Practitioners, to works towards granting CME credit for completing the curriculum.
  - Continue discussions on the topics that the four new modules will cover.
  - Dr. Sessions will attempt to determine whether the University of Hawaii will have to pay for Learnframe's SCORM wrapper.
  - Dr. Birkmire-Peters should send Dr. Sessions Learnframe's quote, once it is available.

University of Hawaii Telemedicine Project: A Web-Based Telemedicine Curriculum

12 December 2002

Project Information

Lab/Company/Group: University of Hawaii

Principal Investigator: Dr. Lawrence P.A. Burgess, MD

Government COR: Dr. Rufus Sessions, PhD

Government Project Officer: Ms. Jessica Kenyon

Contract Instrument: Cooperative Agreement

Period of Performance: 9 Oct 1998 – 30 Jun 03

Contract Specialist: Mr. Danny Laspe

Date Initiated: 9 Oct 1998

EDMS # 2110

Project Description

- To develop a didactic, web-based curriculum to train health care providers in the use of Telemedicine technologies and applications.

- Funding is through the Department of Defense (DAMD17-99-2-9003), U.S. Army Medical Research and Materiel Command, Telemedicine and Advanced Technology Research Center (TATRC) at Fort Detrick, Maryland.

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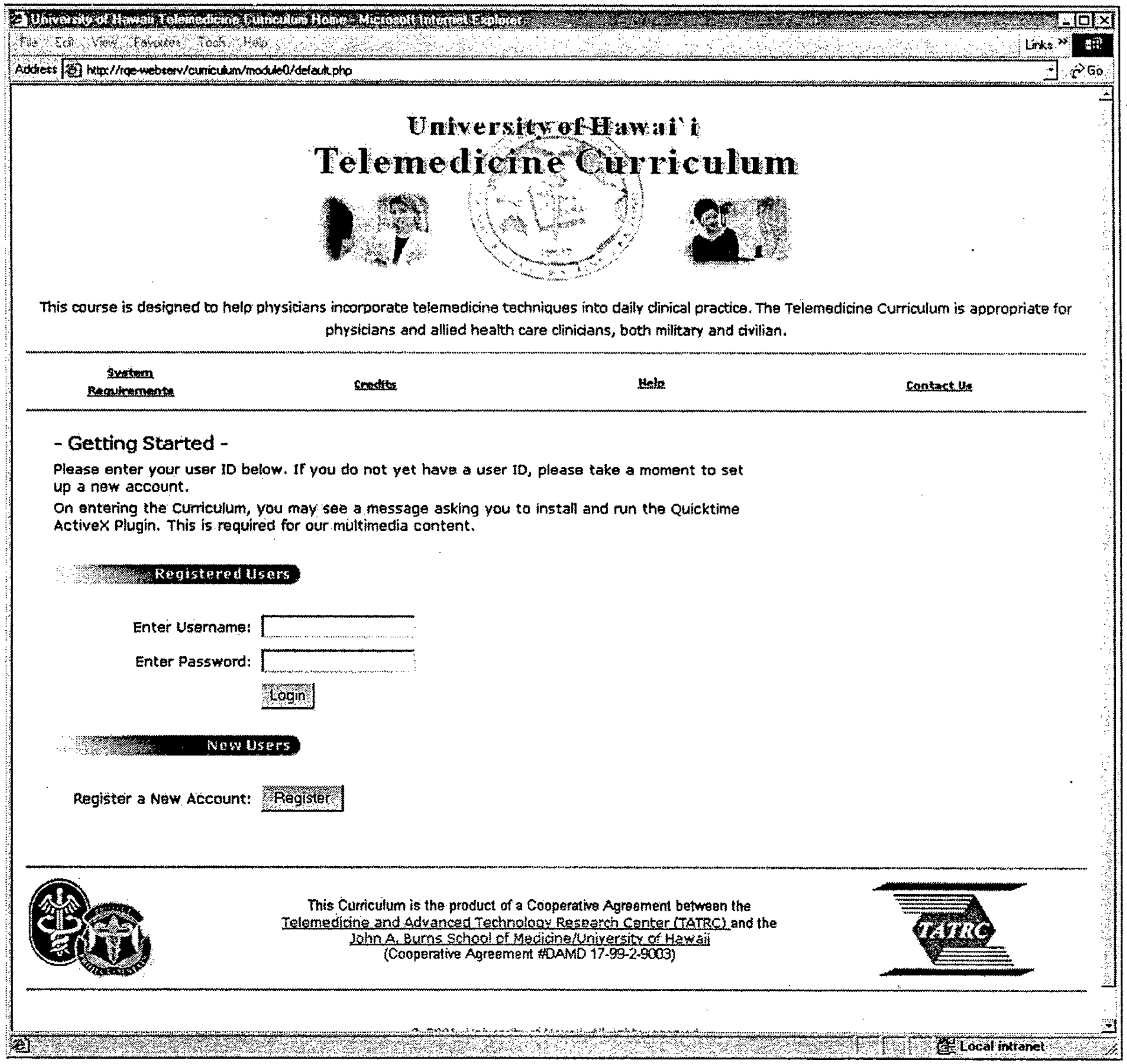
Distance Learning Product Line Review
12 December 2002

Project Description



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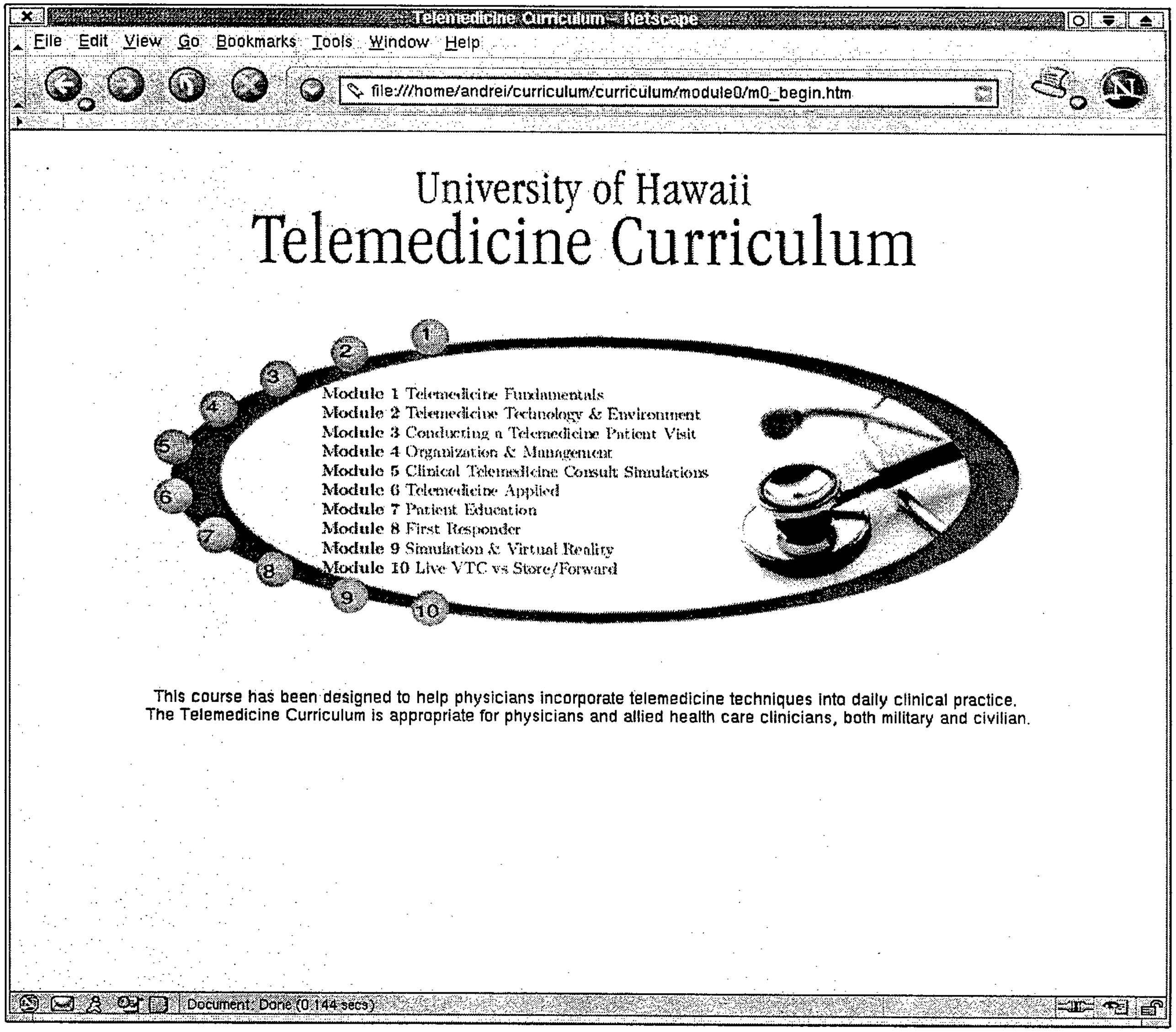
Distance Learning Product Line Review
12 December 2002

Project Description



Project Description

- Module 1: Telemedicine Fundamentals
- Module 2: Telemedicine Technology & Environment
- Module 3: Conducting a Telemedicine Patient Visit
- Module 4: Organization & Management of Telemedicine
- Module 5: Telemedicine Consult Simulations
- Module 6: Telemedicine Applied: Balance Assessment / Audiology

Project Description

- Module 7: Patient Education
- Module 8: First Responder
- Module 9: Simulation & Virtual Reality
- Module 10: Live VTC vs Store/Forward

Potential Benefits

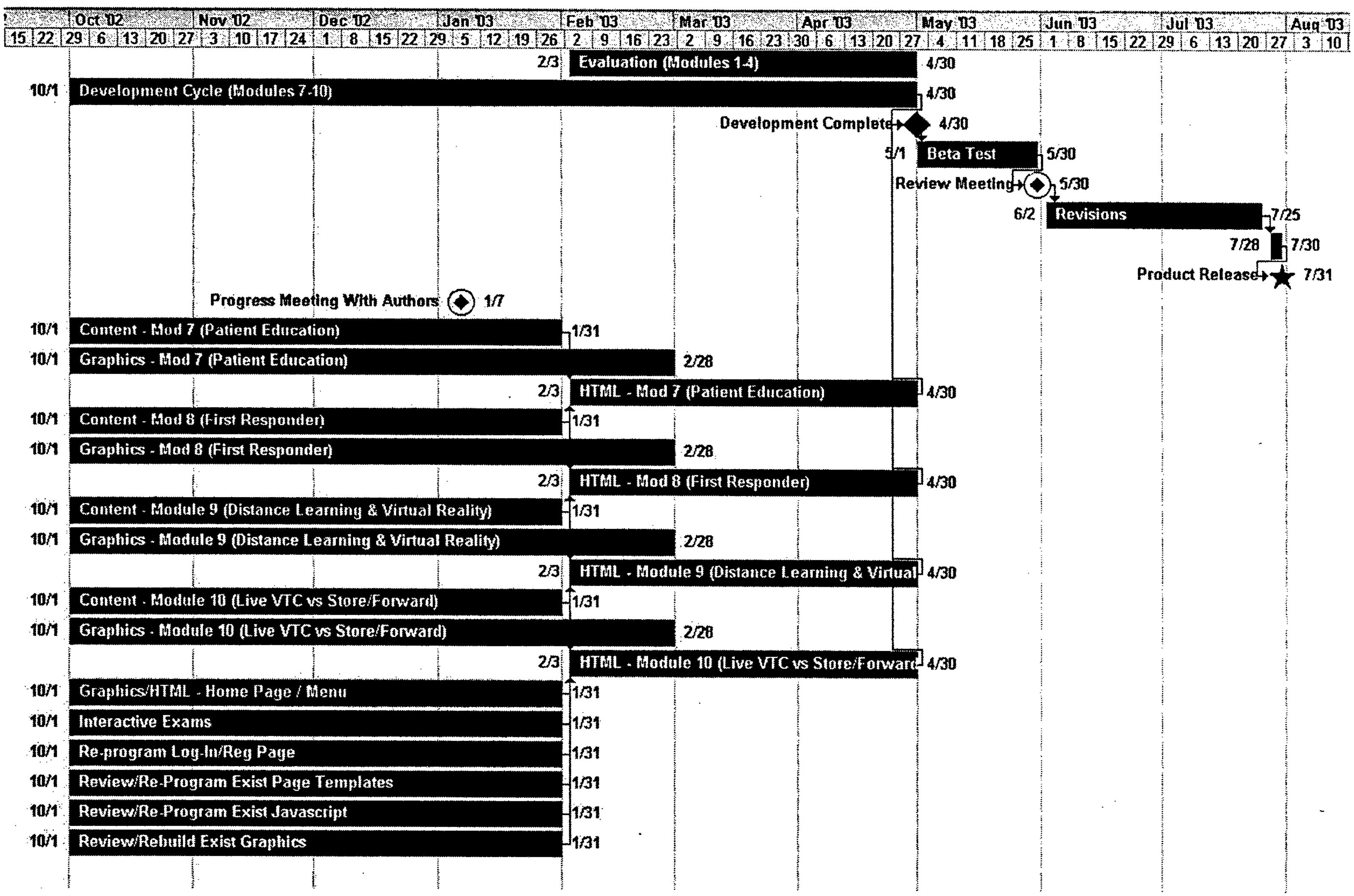
- Investigate advanced telemedicine concepts
- Disseminate telemedicine throughout the DOD
- Web-based
  - Easy access for all users
  - Potential CME credit with no time or geographic barriers
  - Improves distribution
  - Easier updates from lessons learned from recent telemedicine deployments
  - Allows for collection of data for user statistics
- Easily adaptable to the Army Knowledge Network (AKN)

Projected Outcomes

- Evaluate and validate following modules:
  - →Telemedicine Fundamentals
  - →Telemedicine Technology & Environment
  - →Conducting a Telemedicine Patient Visit
  - →Organization & Management of Telemedicine
- Develop the following four modules:
  - →Patient Education
  - →First Responder
  - →Store/Forward vs. VTC
  - →Simulation
- Transfer curriculum to TATRC and DOD

Distance Learning Product Line Review
12 December 2002

Development Timeline



146
147

Project Funding - Execution

Current Budget	Expended Funds	%
$1,715,000	$816,492	48%

Contract Funding

FY	Commitment	Obligation
99	$1,510,523	$1,510,523
00	$989,477	$989,477
01	$857,500	$857,500
02	$857,500	$857,500

Project Coordination

- Tripler Army Medical Center
- AMEDD Center and School
  (COL Robin Teft)
- Pacific Telehealth and Technology Hui
  (Joint DOD / VA Venture)
- Uniformed Services University of the
  Health Sciences

Cost Analysis/Cost Savings

- Distribution costs
  - → Inexpensive to update curriculum with current information
  - → Convenient access to all users

- CME related costs
  - → Travel costs
  - → Time away from duty station
  - → Course and registration fees

Comparison

- Information available in other places, but is fragmented.
- Telemedicine textbooks tend to be out-of-date and unavailable.
- On-line testing is front-leaning and compatible with the state-of-the-art.
- Compliments the efforts of the DOD with the Army Knowledge Network (AKN).

Successes to Date

- Completed six modules and identified 4 additional ones.
- Incorporated on-line testing and scoring.
- Developed evaluation plan for validation of curriculum.
- Initiated contact with AMEDD Center and School for distribution of the curriculum.
- Being used at another university.

FDA / RCQ / Intellectual Property Status

- Shared intellectual property status between University of Hawaii and Government.

- Limited license for intellectual property rights for authors.

- Some code, i.e., search engine, is freely distributable for non-commercial use only.

Publications

University of Hawaii Telemedicine Curriculum

Hall, J. & Saiki, S. (2001). Module 1: Telemedicine fundamentals.

Huhta, D. & Saiki, S. (2001). Module 2: Telemedicine technology & environment.

Huhta, D. & Saiki, S. (2001). Module 3: Conducting a telemedicine patient visit.

Bangert, D. & Doktor, R. (2001). Module 4: Organization & management of telemedicine.

Friedman, R. & Saltman, D. (2001). Module 5: Telemedicine consult simulations.

Yates, J.T., Harmer, S.D., Viirre, E., Campbell, K.H. & Kau, D. (2001). Telemedicine applied: Balance assessment / audiology.

Humphrey, J. (2002, May). Using telemedicine and the chronic disease model to improve quality of diabetes care in Hana. Presentation to the CDC National Diabetes Meeting.

Challenges

Evaluation of first four modules: Desired subject population not easily accessible to independent evaluators.

Take Home Message

- Web-based curriculum good vehicle for distance learning.
- Future projects need a stronger partnership for evaluation.

Appendix G

Evaluation Plan for Measuring the Learning Outcomes of a Telemedicine Curriculum for Department of Defense Health Care Providers

Evaluation Plan
for
Measuring the Learning Outcomes
of
A Telemedicine Curriculum
for
Department of Defense Health Care Providers

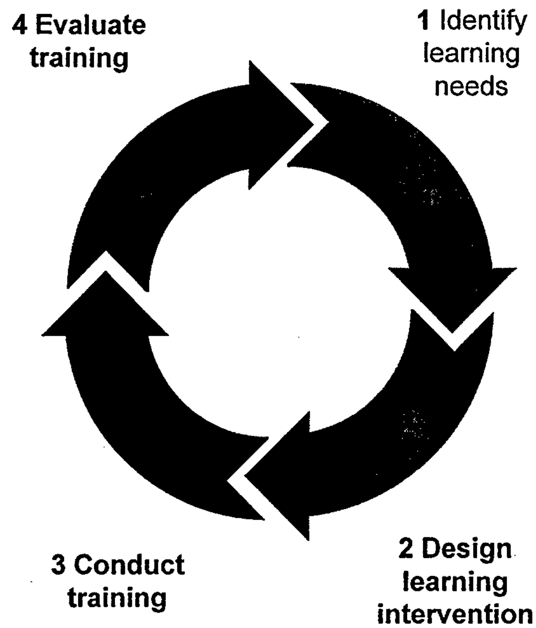
Cooperative Agreement No. DAMD 17-99-2-9003

Table of Contents

Evaluation Plan
for
Measuring the Learning Outcomes
of
A Telemedicine Curriculum
for
Department of Defense Health Care Providers

Cooperative Agreement No. DAMD 17-99-2-9003

Executive Summary



The Training Cycle

The University of Hawaii Telemedicine Team is committed to the training development cycle outlined in the Cooperative Agreement that it has successfully deployed during the initial eighteen months of the period of performance. The cycle has four phases:

1. Identify learning needs
2. Design training
3. Conduct training
4. Evaluate training

Phase one of the training development cycle is the learning needs analysis, which is performed if an organization is experiencing:

1. performance problems,
2. the introduction of a new system, task or technology, or
3. desire to change to benefit from a perceived opportunity.

This analysis was designed and executed during the first year of the Period of Performance. The design and results of the analysis have been submitted as deliverables under the agreement. The analysis defined the four learning clusters and resulting five modules that are currently under development.

1. Fundamentals of Telemedicine
2. Clinical Applications (two modules)
3. Organization and Management
4. Technical Systems

Once the general learning goals are set in the form of learning-goal statements that articulate the basic purpose and outcomes to be achieved, they are divided into three types of learning. The type of learning drives the preferred mode of training. Three major types of learning are easily remembered as "ABC":

1. Affective learning

2. Behavioral learning
3. Cognitive learning

A study of the type of goal will lead to the type of training that is most effective. For example, behavior goals can be thought most effectively by instructor-led training where as cognition goals are effective and cost efficient as web-based training. For affective goals, creating the "cohort" effect is important, regardless if the training is instructor-led or web-based. A deliverable has been submitted that outlines the latest thinking in this evolving field for web-based training.

Once the learning goals are clear, the subject content is determined. Developers ask two questions:
1. What topics should be presented to meet the needs and accomplish the objectives?
2. Who will the participants be? How will they benefit from the program?

Normally, the method of delivery will be explored. However, under the Cooperative Agreement, the full spectrum of choices is not available. The training will be web-based assuming low bandwidth capacity. So choice such as instructor-led and streaming video over the Internet is not possible during the initial two years of the Cooperative Agreement.

The training will take place globally via distance learning at DoD and UH sites that are agreed to by the DoD –UH team. This decision has not been made to date.

The final phase is the evaluation effort. The methodology will follow the Kirkpatrick four-level approach, one that is widely adapted by the private sector. The five modules developed in the first period of performance will continue to undergo evaluation. The new modules will also be evaluated with the same rigor.

The levels of evaluations are:
1. Reaction & planned action, which measures participant satisfaction with the program and captures planned actions.
2. Learning, which measures changes in knowledge, skills, and attitudes.
3. Application, which measures changes in on-the-job behavior.
4. Organizational impact, which measures changes in organizational impact variables.

Motivation for Training Evaluation

There are three common reasons stated for investing in training evaluation:
1. To gain information on how to improve future training programs.
2. To decide whether to continue or discontinue training programs.
3. To justify the funding of training development and delivery.

The evaluation at levels 1 and 2 informs the training design. It provides valuable input to how to make the training better. The UH team will use this input to continuously upgrade the training modules (Reason number one). However, the greater value in the evaluation occurs with levels 3 and 4. These evaluations inform the Needs Assessment (completing the training cycle). If the training fails to change on-job behavior, or if the behavior is

<u>changed, but the organization is not achieving the outcomes desired, the learning objectives derived by the Needs Assessment merits audit (Reason number two). If the training is not positively impacting the desired organizational outcomes, then the reason for the existence of the training comes into question (Reason number 3).</u>

<u>The Four Levels: An Overview</u>
The four levels represent a prescribed sequence for evaluating programs. Each level is important and has an impact on the next level. As you move from one level to the next, the process becomes more difficult and time-consuming, but it also provides more valuable information. None of the levels should be bypassed simply to get to the level that one considers the most important. These are the four levels:

1. Reaction & planned action, which measures participant satisfaction with the program and captures planned actions.
2. Learning, which measures changes in knowledge, skills, and attitudes.
3. Application, which measures changes in on-the-job behavior.
4. Organizational impact, which measures changes in organizational impact variables.

<u>Reaction & Planned Action</u>
As the word reaction implies, evaluation on this level measures how those who participate in the program react to it. It is a measure of customer satisfaction. It is the determinant if the reputation of the program will attract willing participants or if they will be hostages told to go to it by the Command. All participants are customers even if employees of the Department of Defense and they don't pay, and their reactions can make or break a training program. What they say to their supervisors often gets to higher-level leaders, who make decisions about the future of training programs. This level is often called the "Smiley Face" evaluation.

Learning

Learning goals can be defined as one of three types:
1. Cognitive goals are the priority when there is a lack of knowledge. This is often referred to as a "don't know situation.
2. Behavioral goals are the priority when there is a lack of skill. This is often referred to as a "can't do" situation.
3. Affective goals are the priority when there is a lack of desire or fear about using new knowledge or skills. This is often referred to as* a "won't do" situation.

A training program can overcome these three types of challenges. Programs dealing with topics like diversity in the workforce aim primarily at affective learning. Technical programs aim at behavior skills. Cognitive training deals with learning theory and facts like a program describing the effectiveness and use of a new drug. Programs, on topics like leadership, motivation, and communication can aim at all three objectives. In order to evaluate learning, the specific objectives must be determined.

Application

Application (some call this level behavior) can be defined as the extent to which change in behavior has occurred because the participant attended the training program. It is tempting to

bypass levels 1 and 2 -- reaction and learning -- in order to measure if participants are applying the learning on the job site. This is not recommended. For example, suppose that no change in behavior is discovered. The obvious conclusion is that the program was ineffective and that it should be discontinued. This conclusion may or may not be accurate. Reaction may have been favorable, and the learning objectives may have been accomplished, but the level 3 or 4 measures may be disappointing.

In order for change in work place behavior to occur, four conditions are necessary:
1. The person must have a desire to change.
2. The person must know what to do and how to do it.
3. The person must work in the right climate.
4. The person must be rewarded for changing.

The training program can accomplish the first two requirements by creating a positive attitude toward the desired change and by teaching the necessary knowledge and skills. The third condition, right climate, refers to the participant's immediate supervisor. Five different kinds of climate that may impede or encourage change are described in later in this report under the section entitled Level Three: Evaluation.

The fourth condition, rewards, can be intrinsic (from within), extrinsic (from without), or both. Intrinsic rewards include the feelings of satisfaction, pride, and achievement that can occur when change in behavior has positive results. Extrinsic rewards include praise from the boss, recognition by others, workload credits, and monetary rewards, such as merit pay increases and bonuses. This appears to be a major issue in the Department of Defense and implementation of telemedicine programs.

As stated earlier, it is important to evaluate both reaction and learning in case no change in behavior occurs. Then it can be determined whether the fact that there was no change was the result of an ineffective training program or of the wrong job climate and lack of rewards.

Organizational Impact

Organizational impact can be defined as the final results that occurred because the participants attended the program. It is an outcome measure. The final results can include increased production, improved quality, decreased costs, increased utilization, reduced frequency and/or severity of accidents, and reduced personnel. Outcomes such as these are the reason for having some training programs. Therefore, the final objectives of the training program need to be stated in these terms.

Training designers should begin curriculum development by considering the desired outcomes. These results should be determined in cooperation with managers at various levels and across the organization during the Needs Assessment phase. Their participation will give them a feeling of ownership and will probably increase the chances of their creating a climate that encourages change in behavior. The next step is to determine what behaviors will produce the desired results. Then designers need to determine what knowledge, skills, and attitudes will produce the desired behavior.

The final challenge is to present the training program in a way that enables the participants not only to learn what they need to know but also to react favorably to the program. This is the sequence in which programs should be planned. The four levels of evaluation are considered in

reverse. First, we evaluate reaction. Then, we evaluate learning, application, and impact -- in that order. Each of the four levels is important, and we should not bypass the first two in order to get to levels 3 and 4. Reaction is easy to do, and we should measure it for every program. Trainers should proceed to the other three levels as staff, time, and money are available. The next four sections will outline the process to be used in the Cooperative Agreement to include guidelines, forms, and procedures for each level.

Level One: Reaction and Planned Action
Evaluating reaction is measuring customer satisfaction. If training is going to be effective, it is important that participants react favorably to it. Otherwise, they will not be motivated to learn. Also, they will tell others of their reactions, and decisions to reduce or eliminate the program may be based on what they say. Some call the forms that are used for the evaluation of reaction *happiness sheets.* Although they say this in a critical or even cynical way, they are correct. These forms really are happiness sheets. They are not worthless. They help us to determine how effective the program is and learn how it can be improved.

Measuring reaction is important for several reasons. First, it gives us valuable feedback that helps the Department of Defense and University of Hawai'i to evaluate the program as well as comments and suggestions for improving future programs. Second, it tells the participants that the Department of Defense is committed to helping them do their job better and that it desires feedback to determine the training's effectiveness. Third, reaction sheets can provide quantitative information to commanders and others concerned about the program. Finally, reaction sheets can provide military with quantitative information that can be used to establish standards of performance for future programs and training across the enterprise. The basic form for the five modules developed under the cooperative agreement is in Appendix A.

Here are the guidelines that were used in developing the recommended reaction sheets:

1. *Determine what you want to find out.* For each module, we probed for the reactions both to the subject and to the program delivery method. We separated these two ingredients of every module. In addition, we will consider the following factors in customizing the reaction sheets for particular training situation and modules:

- the facilities (location, comfort, and convenience);
- the schedule (time, length of individual modules and total program, breaks, and convenience);
- case studies, exercises, and simulations;
- audiovisual aids within the web-based curriculum (how appropriate and effective);
- printed materials (how helpful, amount, and ease of retrieval); and
- the value that participants place on individual aspects of the module.

1. *Design a form that will quantify reactions.* We sought to find a balance between convenience for the participants and meaningful information for the Deaprtment of Defense. Therefore, the basic, "required" portion of the form is as simple as possible with the participants requested to check a few boxes. Then "optional" portion of the form is open-ended questions that permit in depth comments. Here we look for the reasons behind the numerical responses.

We have strove for the ideal tradeoff that provides the maximum amount of information and requires the minimum amount of time. When a module is over, most participants – especially physicians -- are anxious to leave, and they don't want to spend a lot of time completing evaluation forms. Some may feel that the program designers or Department of Defense do not consider their comments anyway. Therefore, the completion of reaction sheets is designed to be part of the program, completion is necessary to receive credit. Our goal is to have 100% response rate.

2. *Get honest responses.* The form is designed so the individual responses will go to the educational unit responsible for the program and not the command that in which the participant is assigned. Being an on-line, web-based program, in is doubtful that participants will believe that "someone" will not be able to connect the author with the responses.

3. *Develop acceptable standards.* A numerical tabulation can be made of all the forms discussed and shown in this chapter. Exhibit 4.7 shows a tabulation of the reactions of twenty supervisors to the form shown in Exhibit 4.1. The following five-point scale can be used to rate the responses on a form.

Excellent = 5 Very good = 4 Good = 3 Fair = 2 Poor = 1
You tally the responses in each category for all items. For each item, you multiply the number of responses by the corresponding weighting and add the products together. Then you divide by the total number of responses received. For example, you calculate the rating for, item 1, subject, as follows:
(10 X 5 = 50) + (5 X 4 = 20) + (3 X 3 9) + (1 X 2 = 2) + (1 X-1 = 1) = 82
The rating is 82/20 or 4.1

You can use these ratings to establish a standard of acceptable performance. This standard can be based on a realistic analysis of what can be expected considering such conditions as budgets, facilities available, skilled instructors available, and so on. For example, at the University of Wisconsin Management Institute, the standard of subjects and leaders was placed at 4.7 on a five-point scale. This standard was based on past ratings. In this situation, budgets were favorable, and most of the instructors were full-time, professional trainers operating in nice facilities. In many organizations, limitations would lower the standard. You can have different standards for different aspects of the program. For example, the standard for instructors could be higher than the standard for facilities. The standards should be based on past experience, considering the ratings that effective instructors have received.

4. Measure reactions against standards, and take appropriate action.
5. Communicate reactions as appropriate.

Measure Reactions Against Standards and Take Appropriate Action

Once realistic standards have been established, you should evaluate the various aspects of the program and compare your findings with the standards. Your evaluation should include impressions of the coordinator as well as an analysis of the reaction sheets of participants. Several approaches are possible if the standard is not met.

1 .Make a change@-in leaders, facilities, subject, or something else.

2. Modify the situation. If the instructor does not meet the standard, help by providing advice, new audiovisual aids, or something else.
3. Live with an unsatisfactory situation.
4. Change the standard if conditions change.

In regard to the evaluation of instructors, I once faced a situation that I'll never forget. At the Management Institute, I selected and hired an instructor from General Electric to conduct a seminar for top management. He had a lot of experience, both of the subject and in conducting seminars both inside and outside the company. His rating was 3.3, far below our standard of 4.7. He saw that we used reaction sheets and asked me to send him a summary, He also said, "Don, I know that you conduct and coordinate a lot of seminars. I would appreciate your personal comments and any suggestions for improvement." I agreed to do it.

I enclosed a thank-you letter with a summary of the comment sheets. My thank-you tactfully offered the following suggestions, which, I indicated were based on the reaction sheets and on my own observations: "Use more examples to illustrate your points. Give the group more opportunity to ask questions. Ask your audio-visual department to prepare some professional slides and/or transparencies that will help to maintain interest and communicate."
I waited for a thank-you for my constructive suggestions. I am still waiting, and this happened in 1969. 1 did hear through a mutual friend" that the instructor was very unhappy with my letter. He complained that he had taken time from a busy schedule to speak at the University of Wisconsin, he didn't take any fee or expenses, and the only thanks he had gotten was my letter. That was the last time he'd agree to be on our programs.

This example suggests that program coordinators should be very tactful in "helping" instructors by offering suggestions, especially if the instructors are members of top management within their own organization. One practical approach is to let instructors know ahead of time that reaction sheets will be used and that ratings will be compared with a standard. Instructors are usually eager to meet or beat the standard. If they don't, most will either ask for helpful suggestions or decide that someone else should probably do the teaching in the future. This is usually good news for the training staff, who may want to make a change anyway.

Obviously, all reactions that can be tabulated should be tabulated and the ratings calculated. In regard to comments, trainers can either record all comments on a summary sheet or summarize the comments that are pertinent. Tabulations can even be made of similar comments.

Communicate Reactions as Appropriate

Trainers are always faced with decisions regarding the communication of reactions to programs. Obviously, if instructors want to see their reaction sheets, they should be shown them or at least a summary of the responses. Other members of the training department should certainly have access to them. The person to whom the training department reports, usually the manager of Human Resources, should be able to see them. Communicating the reactions to others

depends on two factors: who wants to see them and with whom training staff want to communicate.

Regarding who wants to see them, training staff must decide whether it is appropriate. Is it only out of curiosity, or does the re- quester have legitimate reasons?
Regarding the desire of training staff to communicate the reactions, the question is how often the information should be communicated and in what detail. Those who make decisions about staffing, budgets, salary increases, promotions, layoffs, and so on should be informed. Also, as I suggested in Chapter 1, if there is an advisory committee, its members should be informed. If the concepts and principles described in Chapter 1 have been implemented, the reactions will be favorable, and top management will respect the training department and realize how much the organization needs it in good and bad times.

Summary

Measuring reaction is important and easy to do. It is important be- cause the decisions of top management may be based on what they have heard about the training program. It is important to have tangible data that reactions are favorable. It is important also because the interest, attention, and motivation of participants has much to do with the learning that occurs. Still another reason why it is important is that trainees are customers, and customer satisfaction has a lot to do with repeat business.

This chapter has provided guidelines, forms, procedures, and tech- niques for measuring reaction effectively. Reaction is the first level in the evaluation process. It should be evaluated for an training programs. The responses to reaction sheets should be tabulated, and the results should be analyzed. The comments received from participants should be considered carefully, and programs should be modified accordingly. This measure of customer satisfaction can make or break a training department. It is only the first step, but it is an important one.
PS. If you refer to reaction sheets as "smile" sheets, smile when you do so and hope that participants are smiling when they leave the program!

<u>Level 3 Evaluation</u>

Preventing: The boss forbids the participant from doing what he or she has been taught to do in the training program. The boss may be influenced by the organizational culture established by top management. Or the boss's leadership style may conflict with what was taught.
Discouraging: The boss doesn't say, "You can't do it," but he or she makes it clear that the participant should not change behavior be- cause it would make the boss unhappy. Or the boss doesn't model the behavior taught in the program, and this negative example discourages the subordinate from changing.
Neutral: The boss ignores the fact that the participant has at- tended a training program. It is business as usual. If the subordinate wants to change, the boss has no objection as long as the

job gets done. If negative results occur because behavior has changed, then the boss may turn into a discouraging or even preventing climate.

Encouraging: The boss encourages the participant to learn and apply his or her learning on the job. Ideally, the boss discussed the pro- gram with the subordinate beforehand and stated that the two would discuss application as soon as the program was over. The boss basically says, "I am interested in knowing what you learned and how I can help you transfer the learning to the job."

Requiring: The boss knows what the subordinate learns and makes sure that the learning transfers to the job. In some cases, a contract is prepared that states what the subordinate agrees to do. This contract can be prepared at the end of the training session, and a copy can be given to the boss. The boss sees to it that the contract is implemented. Malcolm Knowles's book *Using Learning Contracts* (San Francisco: Jossey-Bass, 1986) describes this process.

It becomes obvious that there is little or no chance that training will transfer to job behavior if the climate is preventing or discouraging. If the climate is neutral, change in behavior will depend on the other three conditions just described. If the climate is encouraging or requiring, then the amount of change that occurs depends on the first and second conditions.

References

Geri E.H. McArdle, *Conducting a Needs Analysis*, Crisp Publications, 1998.

Laurie J. Bassi and Darlene Russ-Eft, editors, *Assessment, Development, and Measurement,* American Society for Training and Development, 1997.

Jack J. Phillips and Elwood F. Holton III, editors, *Conducting Needs Assessment,* American Society for Training and Development, 1995.

Mel Silberman, *Active Training,* second edition, Jossey-Bass, 1998/

Fernandol. Soriano, *Conducting Needs Assessments: A Multi-disciplinary Approach*, Sage Publications, 1995.

Appendix H

Reaction Questionnaires

Reaction to Telemedicine Fundamentals Module

In order to determine the effectiveness of this module in meeting your needs and interests, we need your input. Please give us your reactions, and make any comments or suggestions that will help us serve you. Please click on the appropriate response after each statement. Your responses are confidential and will be used to improve this module.

	Strongly Disagree				*Strongly Agree*
The material covered was relevant to my duties.	1	2	3	4	5
The course objectives were adequately explained.	1	2	3	4	5
The module was well organized.	1	2	3	4	5
The material was presented in an interesting way.	1	2	3	4	5
The module communicated the material effectively.	1	2	3	4	5
The audiovisual effects were effective.	1	2	3	4	5
I will be able to apply much of the material to my current assignment.	1	2	3	4	5
As the module progressed, my questions were answered.	1	2	3	4	5

9. Please mark the three most useful sections:

Philosophy of Telemedicine	Telemedicine and the U.S. Department of Defense	Barriers to Telemedicine Success
History of Telemedicine	Prison Telemedicine	Patient Perspective
Telemedicine Networks	Home Health and Telemedicine	Physician Perspective
		Telemedicine Resources

10. Please mark the three least relevant sections:

Philosophy of Telemedicine	Telemedicine and the U.S. Department of Defense	Barriers to Telemedicine Success
History of Telemedicine	Prison Telemedicine	Patient Perspective
Telemedicine Networks	Home Health and Telemedicine	Physician Perspective
		Telemedicine Resources

11. Please mark any sections that remain confusing or unclear:

Philosophy of Telemedicine	Telemedicine and the U.S. Department of Defense	Barriers to Telemedicine Success
History of Telemedicine	Prison Telemedicine	Patient Perspective
Telemedicine Networks	Home Health and Telemedicine	Physician Perspective
		Telemedicine Resources

12. How was the pace of the module? 1 2 3 4 5

Too slow ... *Too fast*

13. How was the level of difficulty of the module?

1 2 3 4 5

Hard to understand ... *Too easy*

14. What would have improved the module?

15. Other comments?

Reaction to Telemedicine Technology and Environment Module

In order to determine the effectiveness of this module in meeting your needs and interests, we need your input. Please give us your reactions, and make any comments or suggestions that will help us serve you. Please click on the appropriate response after each statement. Your responses are confidential and will be used to improve this module.

	Strongly Disagree				***Strongly Agree***
1. The material covered was relevant to my duties.	1	2	3	4	5
2. The course objectives were adequately explained.	1	2	3	4	5
3. The module was well organized.	1	2	3	4	5
4. The material was presented in an interesting way.	1	2	3	4	5
5. The module communicated the material effectively.	1	2	3	4	5
6. The audiovisual effects were effective.	1	2	3	4	5
7. I will be able to apply much of the material to my current assignment.	1	2	3	4	5
8. As the module progressed, my questions were answered.	1	2	3	4	5

9. Please mark the three most useful sections:

Telemedicine Modalities	Video-Ophthalmoscope	Room Design
General Examination Camera	Light Platform	Communications Requirements
Video-Otoscope	Telemedicine Stethoscope	Telemedicine Equipment Installation
Dermascope	Telemedicine Connections	

10. Please mark the three least relevant sections:

Telemedicine Modalities	Video-Ophthalmoscope	Room Design
General Examination Camera	Light Platform	Communications Requirements
Video-Otoscope	Telemedicine Stethoscope	Telemedicine Equipment Installation
Dermascope	Telemedicine Connections	

11. Please mark any sections that remain confusing or unclear:

Telemedicine Modalities	Video-Ophthalmoscope	Room Design
General Examination Camera	Light Platform	Communications Requirements
Video-Otoscope	Telemedicine Stethoscope	Telemedicine Equipment Installation
Dermascope	Telemedicine Connections	

12. How was the pace of the module?

1	2	3	4	5
Too slow				***Too fast***

13. How was the level of difficulty of the module?

1	2	3	4	5
Hard to understand				***Too easy***

14. What would have improved the module?

15. Other comments?

Reaction to Conducting a Telemedicine Patient Visit Module

In order to determine the effectiveness of this module in meeting your needs and interests, we need your input. Please give us your reactions, and make any comments or suggestions that will help us serve you. Please click on the appropriate response after each statement. Your responses are confidential and will be used to improve this module.

	Strongly Disagree				***Strongly Agree***
1. The material covered was relevant to my duties.	1	2	3	4	5
The course objectives were adequately explained.	1	2	3	4	5
The module was well organized.	1	2	3	4	5
The material was presented in an interesting way.	1	2	3	4	5
The module communicated the material effectively.	1	2	3	4	5
The audiovisual effects were effective.	1	2	3	4	5
I will be able to apply much of the material to my current assignment.	1	2	3	4	5
As the module progressed, my questions were answered.	1	2	3	4	5

9. Please mark the three most useful sections:

Introduction (Human Factors)	Patient Preparation	Wrap-up
Select Modality	Clinician Preparation	Documentation
Scheduling	Real Time Examination	Equipment Shutdown
Equipment Set-up	Store/Forward Virtual Visit	Diagnostic Devices

10. Please mark the three least relevant sections:

Introduction (Human Factors)	Patient Preparation	Wrap-up
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11. Please mark any sections that remain confusing or unclear:

Introduction (Human Factors)	Patient Preparation	Wrap-up
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12. How was the pace of the module? 1 2 3 4 5

Too slow ... *Too fast*

13. How was the level of difficulty of the module?

1 2 3 4 5

Hard to understand ... *Too easy*

14. What would have improved the module?

15. Other comments?

Reaction to Organization and Management Module

In order to determine the effectiveness of this module in meeting your needs and interests, we need your input. Please give us your reactions, and make any comments or suggestions that will help us serve you. Please click on the appropriate response after each statement. Your responses are confidential and will be used to improve this module.

	Strongly Disagree				***Strongly Agree***
2. The material covered was relevant to my duties.	1	2	3	4	5
The course objectives were adequately explained.	1	2	3	4	5
The module was well organized.	1	2	3	4	5
The material was presented in an interesting way.	1	2	3	4	5
The module communicated the material effectively.	1	2	3	4	5
The audiovisual effects were effective.	1	2	3	4	5
I will be able to apply much of the material to my current assignment.	1	2	3	4	5
As the module progressed, my questions were answered.	1	2	3	4	5

9. Please mark the three most useful sections:

Introduction (Adm. Wright)	Legal & Technical Barriers	Participant Empowerment
Five Reasons for Failure	AMEDD Study: Telemedicine Barriers	Innovation, Learning & Evaluation (MG. N Adams)
Unproven Clinical Quality	Expert Advice (Dr. J Logan)	Champions
Business Management Barriers	Expert Advice (Col. H Hassell)	Organizational Learning Culture
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Appendix I

Knowledge Assessment Questionnaires

MODULE 1 TEST QUESTIONS

TELEMEDICINE FUNDAMENTALS

1. Telemedicine can include:

a) Delivery of medical services over distance
b) Medical education using interactive CD technology
c) Patient information in electronic files
d) Administration of Physical Therapy in a hospital
e) Health Care Administration in a network of multiple hospitals

Ans: a, (1.0.0)

2. Telemedicine networks can be:

a) Hub-and-Spoke
b) End-to-end
c) Circular
d) Branching
e) Nested

Ans: b (1.3.0)

1. Telemedicine can be described as a(n) _______ to use in the practice of medicine.

a) New tool
b) Evolving tool
c) Widely accepted tool
d) Cost effective tool

Ans: b (1.2.0)

2. Which of the following is a well-documented barriers to the use of telemedicine?

a) Monetary issues
b) Patient acceptance
c) Network capability
d) Software development
e) Equipment compatibility

Ans: a (3.0.0)

3. In general, the vast majority of issues surrounding telemedicine are not very different from the issues that exist with more traditional health care deliver. True or False

Ans: True (1.1.0)

4. **The most frequently cited barrier to long-term sustainability of civilian telemedicine programs is related to __________:**
   a) Concerns about insurance reimbursements
   b) Equipment costs
   c) Physician acceptance
   d) Patient acceptance

Ans: a (3.1.0)

5. **Telemedicine has been recognized as a tool well suited for prison patient populations on the basis of _________:**
   a) Legal considerations
   b) Cost-benefit analyses
   c) Liability considerations
   d) Patient acceptance
   e) Insurance reimbursement issues

Ans: b (2.2.0)

6. **Which of the following are not communication methods for tele-homecare?**
   a) Cable TV
   b) Stand-alone video-telephone units
   c) Video-telephone systems incorporated into television sets
   d) Automated pre-recorded reminder messages sent by telephone
   e) fax

Ans: e (2.3.0)

7. **If "Televisits" by health care workers are essentially a return to house calls, albeit over distance. Why hasn't this service become more common?**
   a) Patients have generally reported a low level of satisfaction with tele-homecare
   b) Physicians are reluctant to try new technologies
   a) Saving travel time for patients is not a high priority
   b) Equipment costs for patients and physicians are limiting
   c) Insurance reimbursement issues

Ans: e (2.3.0)

8. **Malpractice claims regarding telemedicine are a major concern since they are becoming increasingly common.**
   a) True
   b) False

Ans: b (3.2.3)

9. **Patients who are good candidates for telemedicine include.**
   a) Those with a language barrier
   b) Those with hearing or vision problems
   c) Deployed military personnel
   d) Those with psychosis

e) Very old or very young patients

Ans: c (4.1.0)

10. The telemedicine orientation exercise does not include which of the following?

a) Hands-on demonstration of practice with use of telemedicine workstations and peripheral devices
b) Simulated distance examination
c) Face-to-face examination
d) Feedback from the patient
e) Review of appropriate check lists

Ans: e (3.3.2)

11. A Telemedicine Site Coordinator is responsible for the following functions.

a) Scheduling issues
b) Training of physicians, nurses, schedulers, and office assistants, billing personnel, therapists and other allied health care personnel
c) Champion for the telemedicine service

Insures equipment and communications operating correctly

Billing for services

Ans: e (3.3.4)

12. Which of the following factors are prominent benefits of telemedicine for physicians?

a) Interacting with colleagues worldwide
b) Simultaneous care with both the specialist and primary care physicians
c) Longer time intervals between referral and specialist consult appointments
d) Ease of scheduling simultaneous appointments with two physicians or caregivers
e) Reduced cost for physician's office

Ans: b (4.2.0)

13. Which of the following factors are benefits of telemedicine for patients?

a) Rapport building through tactile contact
b) Sense of isolation
c) Improvement in compliance
d) Instant access to a healthcare provider
e) Reduced cost for patient

Ans: c (4.1.0 and 4.2.0)

MODULE 2 TEST QUESTIONS

TELEMEDICINE TECHNOLOGY AND ENVIRONMENT

1. Telemedicine communication across distance can occur in either real-time, store/forward, or both real-time and store/forward. Which of the following form of telemedicine communication is most frequently associated with both real-time and store/forward applications?

a) Telephone, voice mail, and fax
b) Electronic-mail
c) Video Teleconferencing (VTC)
d) Internet/Web-base applications
e) None of the above

Ans: a (2.2.0)

2. Advantages of store/forward telemedicine applications include:

a) Requires less bandwidth and can be used with analog modems connected to regular telephone lines
b) Timing and scheduling are more flexible as both sender and receiver do not need to be present at the same time
c) Usually provides immediate feedback
d) a and b above
e) All of the above

Ans: d (2.3.0)

3. DICOM

a) Is an acronym meaning Digital Imaging and Communication in Medicine
b) Is a set of standards governing capture, storage, transfer and retrieval of radiological images
c) Compliancy insures that images can be transmitted and viewed on any DICOM-compliant workstation, regardless of manufacturer.
d) Both b and c
e) All of the above

Ans: e (2.3.2)

4. Which of the following digital image formats would not be suitable for store/forward applications?

a) TIFF
b) JPEG
c) Bitmap
d) Both a and c
e) All of the above

Ans: a (2.3.4)

5. Real time telemedicine VTC connections are usually not used for:

a) Psychiatry
b) General medicine
c) Situations where motion contributes to the diagnosis
d) Situations where effective patient-provider communication is important
e) Radiology

Ans: e (2.4.0)

6. ________ is measured in bits-per-second (bps).

a) Bandwidth
b) Frame rate
c) Resolution
d) Both a and b
e) All of the above.

Ans: a (2.4.1)

7. ______________ is measured in pixels in computer-based applications.

a) Bandwidth
b) Frame rate
c) Resolution
d) Both a and b
e) All of the above.

Ans: c (2.4.1)

8. ______________ describes how sharp the individual frames are.

a) Bandwidth
b) Frame rate
c) Resolution
d) Both a and b
e) All of the above.

Ans: c (2.4.1)

9. _________ provides digital connection with a bandwidth of 128K per line that can be bonded together for higher bandwidths.

a) CODEC
b) POTS
c) ISDN
d) IP
e) All of the above

Ans: c (2.4.1)

10. The CODEC:

a) Converts analog to digital signals and vice versa
b) Compresses the two-way audio and video streams
c) Provides the means to connect all VTC devices (including cameras and microphones)
d) Both b and c
e) All of the above

Ans: d (2.4.2)

11. Web-based applications of telemedicine are best for:

a) Lower bandwidth asynchronous communications where the information is sent to the recipient and stored in a convenient location until accessed
b) High bandwidth applications such as real-time VTC
c) Multi-station VTCs between distant locations
d) Monitors the content of the information transmitted
e) All of the above

Ans: a (2.5.0)

12. Video cameras:

a) Are not sensitive to the color temperature of the light source illuminating the patient
b) Must be calibrated to the color temperature of the light source to provide accurate color in the picture.
c) Need to be "White Balanced"
d) Both b and c
e) None of the above

Ans: d (3.1.0)

13. Major sources of frame rate reduction include:

a) Motion
b) Complexity of the image
c) Bandwidth
d) Both a and c
e) All of the above

Ans: e (4.2.0)

14. Compression algorithms are used to reduce the volume of information sent over the link. These algorithms are sensitive to how much of the video picture changes from one frame to the next since it does not transmit the portions of the frame which do not change, and only updates those that do.

a) True
b) False

Ans: a (4.2.0)

15. 256K is achieved by bonding two ISDN lines together and can maintain close to 30 fps for subjects with little motion. Moderate or greater motion will reduce the frame rates to between 15 fps and 25 fps.

a) True

b) False

Ans: a (4.3.0)

16. The environment in which the telemedicine activities take place can have a large impact on the outcome. Which of the following factors need to be considered to insure a successful video teleconference?

a) Power requirements

b) Noise level

c) Room layout and equipment configuration

d) Lighting

e) All of the above

Ans: e (5.1.0)

MODULE 3 TEST QUESTIONS

CONDUCTING A TELEMEDICINE PATIENT VISIT

1. Which of the following represent challenges to the implementation and sustainment of a telemedicine program?

a) Scheduling the increased number of individuals involved
b) Varying procedures and/or protocols
c) Provider resistance to new technologies
d) a and c
e) a, b and c

Ans: e (1.1.0)

2. The key actions necessary for a successful telemedicine visit include all <u>except</u> the following:

a) Scheduling (patient, referring site, and consulting site)
b) Patient preparation
c) Provider preparation at send/referring and receive/consultant sites
d) Real-time examination or store/forward consultation
e) Determine how billing will be handled between referring site, consulting site, and the patient

Ans: e (2.0.0)

3. Orientation and initial training on telemedicine applications should be:

a) Given during normal clinic hours so as to provide the most realistic environment
b) Given outside of normal clinic hours to minimize interruptions
c) Given within the clinic environment to maximize transfer of training
d) a and c

Ans: b (1.1.0)

4. The referring provider is responsible for:

a) Assessing the suitability of the patient for tele-consultation (psychosis, language barriers, hearing/vision difficulties)
b) Scheduling patient at send/referring and receive/consulting sites
c) Forwarding medical records of patient to receive site
d) Completing patient orientation
e) All of the above

Ans: E (2.5.0)

5. It is crucial to begin each real-time telemedicine visit with complete introductions and all individuals involved on camera should be introduced. However, at times there may be personnel present who are not seen by the patient on the monitor and these individuals should not be identified, to prevent the patient from being confused by their presence.

a) True
b) False

Ans: b (2.7.0)

6. The most critical factor in a virtual or store/forward consultation include:

a) The accurate gathering and timely transmission of the information needed by the consulting physician
b) The ability to give the patient immediate feedback
c) The ability to annotate the patient information electronically
d) The timely transmission of information from the consulting physician to the referring physician
e) All of the above

Ans: a (2.8.0)

7. The results of a patient's audiometric screening show a significant threshold shift in hearing. The patient's history indicates that he is employed as a floor supervisor in a factory manufacturing industrial equipment. Which of the following courses of action would be the most appropriate and efficient?

a) Record a video image of the middle ear and send the electronic image to an otologist for evaluation for pathology
b) Schedule a video-teleconference with the patient and an otologist
c) Repeat the audiometric testing in 30 days and if the hearing loss persists, schedule an appointment with an otologist
d) Repeat the audiometric testing, because the hearing loss is likely due to noise and will correct itself
e) No action is necessary

Ans: a (2.8.0)

8. At the conclusion of the telemedicine visit, the patient should be invited to ask any further questions of the consultant, the local provider, and any other participant. The patient's comfort level and satisfaction with use of the telecommunications equipment should also be briefly assessed.

a) True
b) False

Ans: a (2.9.0)

9. The light platform/control unit:

a) Contains a high-intensity light source, such as, a xenon or halogen bulb, and the electronics to support a video camera
b) Can be balanced to accommodate a variety of light conditions
c) Connects to a cable that contains a “chip” camera
d) a and c
e) a, b and c

Ans: d (3.1.0 & 3.1.1)

10. To white balance the camera, point the camera or endoscope at a white surface and then hold the color reset button for 3-4 seconds.

a) True
b) False

Ans: a (3.1.3)

11. Most of the various telemedicine diagnostic devices are very similar to their non-telemedicine counterparts so very little, if any, practice is needed once the physician is familiar with using the standard instrument.

a) True
b) False

Ans: b (3.0.0)

12. When arranging the patient relative to the video monitor the patient must always be able to see the monitor clearly. The recommended arrangement is for the monitor to be facing the patient since the physician may move around and will not always be in the direct line of sight.

a) True
b) False

Ans: b (3.2.2)

13. The Exam Camera can also be used as a "document camera" when used with a tripod and for x-rays when used with a light-box. Additionally, when cost is a factor, the exam camera can replace the top-mounted camera on many video units.

a) True
b) False

Ans: a (3.5.2)

14. When using a digital stethoscope for real time transmission, it is best to use the audio channel of an existing videoconference system, since VTC is likely to already be in use for the telemedicine visit.

a) True
b) False

Ans: b (3.6.2)

15. The intent of a telemedicine visit is identical to that of a traditional face-to-face visit. However, it is imperative to also take into account the unique aspects associated with telemedicine for the examination to be a successful experience. Which of the following will be the most powerful predictor of success in a telemedicine service?

a) Available bandwidth
b) Equipment acquisition
c) Scheduling
d) a and b
e) a, b and c

Ans: c (1.1.0)

MODULE 4 TEST QUESTIONS

ORGANIZATION AND MANAGEMENT

1. **Circle a main barrier to telemedicine:**
   a) Spatial Issues
   b) Time Issues
   c) Organizational Issues
   d) Societal Issues
   e) Professional Issues

Ans: c

2. **How Can an Empowered Health Care Providers Overcome Barriers to Telemedicine?**
   a) Reduce telemedicine cost by using only when necessary
   b) Study the workflow and propose ways to modify and facilitate telemedicine
   c) Insure quality by using telemedicine for less challenging cases
   d) Use only when distances between patient and HCP are greater than 10 miles
   e) Ask legal consultants to facilitate use

Ans: b

3. **Clinical Quality concerns become a barrier to telemedicine because:**
   a) Clinical evaluation studies have not conclusively demonstrated telemedicine delivers care equivalent to the "gold standard."
   b) The distance that separates a health care provider and a patient during telemedicine serves to reduce the quality of the clinical assessment that may be made.
   c) The high-touch part of medicine is lost to this technology.
   d) HCP prefer to have face to face interaction with patients and colleagues in order to gain important insights from non-verbal cues.
   e) Technology glitches can occur at inopportune times.

Ans: a

4. **Telemedicine programs that contain a rigorous evaluation effort have a better chance to achieve high utilization rates.**
   a) True
   b) False

Ans: a

5. **For telemedicine to succeed, the organization implementing telemedicine needs to embrace a positive organizational learning culture.**
   a) True
   b) False

Ans: a

6. **In a telemedicine effort, one must emphasize the appropriate technology and the medicine will follow.**
   a) True
   b) False

Ans: b

7. **It is important to have a "techie" in charge of the telemedicine effort.**
   a) True
   b) False

Ans: b

8. **What is an important reimbursement requirement for telemedicine success:**
   a) Primary care and specialists physicians need to split reimbursement credit
   b) Rural under-served counties need Medicaid reimbursement of telemedicine more than urban areas.
   c) In the military, workload credit must be fairly accounted for all parties in telemedicine encounters.
   d) Reimbursements must be sufficient to allow all HCP's to receive their usual and customary fee.
   e) Reimbursement must be the same for store and forward telemedicine as it is for two way interactive video telemedicine.

Ans: c

9. **An Important factor to consider when matching the telemedicine technology to medical needs is that one needs to use equipment all from one manufacturer to insure greater medical accuracy and ease workload on health care provider.**
   a) True
   b) False

Ans: b

10. **To effectively market telemedicine one must determine the cost and "price" of the telemedicine solution.**
    a) True
    b) False

Ans: b

11. **Most telemedicine implementations require Business Process Re-engineering.**
    a) True
    b) False

Ans: a

12. The key to cost effective implementation of telemedicine lies in high rates of utilization.

a) True
b) False

Ans: a

13. An organization which has a committed and strong strategic intent to implement telemedicine will be eventually successful with telemedicine.

a) True
b) False

Ans: b

14. A cost of poorly implemented and failed telemedicine efforts is diminished communication between generalists and specialists.

a) True
b) False

Ans: b

15. Breakdowns in the technical system remain the single most significant cause of telemedicine failure.

a) True
b) False

Ans: b

Appendix J

Publications

The successful integration of telemedicine into the Chronic Disease Model in a rural setting

Joseph Humphry, MD, FACP and Deborah Birkmire-Peters, Ph.D.

The health care system is relatively slow in adopting new technology. In an age where we can access almost unlimited information, interact with friends and strangers, and manage most of financial transaction, medical services provision is almost non-existence. Efforts to improve care, increase access and exploit new technology has met with substantial resistance and often failed. Telemedicine initially promised to improve communication and access to care. Even though there have been notable success and acceptance of certain technologies such as digital imagine, projects focused on video conferencing have often not proving to be viable beyond the funding. There are a number of barriers to the sustainability of telemedicine through video conferencing. The lack of system changes to maximize efficiency and compensation are major factors. Providers and patients acceptance appears to be a second barrier leading to the demise of a number of projects.

The care for patients with chronic disease is relatively ineffective and inefficient. The science provides evidence as to best practices, but population based studies repeatedly show a majority of the patients receive less than quality care. Even the best centers for diabetes care fail to achieve desirable intermediate outcomes for many patients. The NHANES data found that only 27% of patients with hypertension have acceptable blood pressure control. (JNC VI) The system of health care is recognized as a major barrier in the delivery of effective chronic disease care. The chronic disease model addresses the major weaknesses in the existing system and provides a structure that promotes system changes and improved care. (Ed Wagner)

Chronic disease management in rural American faces major barriers beyond those inherent in the health care delivery system. The rural areas lack resources and experts to effectively management patients with chronic illness. Contact with specialists is often infrequent and lacks coordination. The chronic disease model requires an integrated team approach to care with a focus on patient self management. Patients often find themselves learning aspects self-management independent of the health care system due to the relative lack of secondary and tertiary care.

Using the chronic disease model and concept of the rapid change model developed by the Institute of Healthcare Improvement, we implemented a program for diabetes care in a rural health system that used telemedicine an integral part of the evolving delivery system. Through both the use of video-conferencing and a web-based application, the program supports team development, improves patient access and monitors care and outcomes.

Site: Hana is a rural community on the island of Maui that is approximately 2 ½ hours from the urban center and hospital. The population is over 2000 people with 62% Hawaiian or part Hawaiian. The principle and only major industry is tourism. Health

care is provided by a single community health center that is staffed by physicians providing 24 hours a day coverage and 7 days a week. The community lost their primary care provider 2 and ½ years ago and is currently staffed by locums. The health center has single part time nurse with the rest of the clinical staff hired from the community with limited medical experience.
Methodology: The diabetes program was developed around the chronic disease model. The staff of the clinical was oriented to the rapid change model in the first two months of the program, but had not formal training from the Institute of Healthcare Improvement or other trainers. The staff had explicit understanding up the diabetes team. The diabetes expert had face to face patient visits every other week for one day with alternative tele-video visits with the distant site on Oahu.

The initial plans were to establish a doctor-patient relationship with the patients, set up self-management and care plans, and manage unstable patients with the face to face visits using the telemedicine for stable planned visits. All patients have the option to use the video conferencing or the telemedicine. The health center was hiring a permanent primary care physician and the original plan was to develop the team around the permanent physician with co-management of difficult patients or those who were unstable.

Initially, delivery design would use a diabetes flow sheet, but the patient tracking would be transferred to a web based application when it became available. In the meantime, pertinent medical records were faxed for the telemedicine video conferences. The web based application would eliminate or substantially reduce the need to fax.

The physician expert was paid by the health center for hours of patient contact either at the center or over telemedicine. Travel expenses and the cost of the phone lines were also paid for by the health center. Technical support for the project was provided from the University of Hawaii Telemedicine Program. There are no external funds for the program.

Results: The telemedicine component of the program was rapidly implemented starting a week after the first visit. The telemedicine visits have continued as scheduled since that time. The number of patients seen has varied from zero on days when patients have cancelled to 6 with the usual number between 2 and 3.

The initial acceptance of the video conferencing has waned. Initially, most patients were enthusiastic or accepting, but as the program evolved the novelty of the "television" has worn off. The majority of the patients have expressed a preference for face to face encounters. The concept of using the telemedicine for follow up visits for stable patients did not become feasible do to the patient's preference. Older patients with hearing, visual or memory problems do not do well with the video conferencing.

The telemedicine has been very effective in two distinct situations. When patient are unstable or require a change in treatment plans, telemedicine allows for one week follow-up. There have been several occasions where patients have had progressive heart failure,

exacerbation of asthma or poorly controlled diabetes where one week follow-up has been critical for follow-up and management. When the patient has an unstable condition they have all been very willing and cooperative with telemedicine follow-up and prefer maintaining contact with specialty care rather than the health center physician.

The second situation where the video conferencing has been effective is when patients need increased time for evaluation or education. The videoconferencing allows scheduling for up to an hour of time. There are selected patients that preferentially schedule for telemedicine visits when they want additional time. The provider also has used the additional flexibility to extend a face to face visit. Again, it is important that the telemedicine visit is discussed with the patient prior to the visit. There has been a significant no show rate when the patient has been scheduled without the provider getting the patients willingness to participate.

Telemedicine visits have been used for initial visits on several occasions. This approach has been necessary when the onsite schedule has been fully booked. The initial plans called for initial face to face visits, but the telemedicine visit has worked well as long as the visit is followed up in a timely manner with a face to face visit. The novelty of the videoconferencing may partly account for the receptiveness of patients to see a new physician over video conferencing.

The Chronic disease model and clinical outcome: In conjunction with the introduction of the video conferencing, there has been significant changes and education at the health center. The system design changes have allowed for a greater focus on patient self management and adherence to practice standards. Specific changes are beyond the discussion in this article with a focus on telemedicine. The telemedicine has been introduced as a part of the system designs.

The following table shows the process and outcome measures for patients seen in the last 3 months after 15 months of the program. The measures are the clinical indicators for the ADA provider recognition program.

Demographics

	M	F
Sex	42%	58%

Age Distribution

	N	Percent
45-54	5	21%
55-64	6	25%
65-74	9	38%
75-84	4	17%

Results

	Frequecy	Hana N=24	ADA Rec	HI Hedis 2001
HbA1c	1 time/yr	100%	93%	79%
Proportion w/HbA1c < 8%	(most recent test)	83%	55%	
Proportion w/HbA1c > 9.5%	(most recent test)	0	≤ 21%	51%*
Eye exam	1 time/yr*	54%	61%	56%
Foot exam	1 time/yr	71%	80%	
Blood pressure frequency	1 time/yr	100%	97%	
Proportion < 140/90 mm Hg	(most recent test)	75%	65%	
Nephropathy assessment	1 time/yr	100%	73%	53%
Lipid profile	1 time/yr	96%	85%	82%
Proportion w/LDL < 130 mg/dl	(most recent test)	75%	63%	49%

Additional Results

Measures	Hana N=24
2 A1c in year	83%
ACE	83%
Statin	67%
ASA	88%
Flu	58%
Pneu	83%

Discussion: People in rural communities face significant problems in accessing quality health care. As exemplified by the Hana community there are problems in recruiting and

retaining professional staff. In addition, they lack the knowledge and administrative support to make system changes to improve chronic disease care. Telemedicine has attempted to address these problems through setting up consultation services to increase access to secondary and tertiary care. Many of these programs have focused on using video conferencing to replace referrals to specialty care in urban centers. The technology has clearly improved access, but for a number of reasons, the programs have not had wide spread acceptance and sustainability.

The diabetes program at the Hana Community Health Center focused on changing the structure of care at the health center based on the chronic disease model. The telemedicine was introduced as an integral part of the program and a method to increase specialty contact. Using the chronic disease model, the system of care at the Hana Community Health Center was restructured to better address the needs of patients with diabetes. The introduction and application of tele-health was part of the larger system change implemented at the health center.

One of the key elements related to the sustained application of video conferencing was the relationship that the consultant developed with the patients through face to face visits. Many programs have focused on developing the doctor patient relationship over video conferencing. The doctor-patient relationship is a core component to improving care. Patients should not be expected to rapidly accept telemedicine as a way to develop a positive relationship with a provider. This concept is especially true in rural communities with cultural diversity such as Hana, but the same principle holds across most if not all setting where telemedicine might be effective.

A second component of building the diabetes program was the early and continued involvement of the staff and community. In a rural community, the employees of the health center know most if not all the patients in the community. As the staff better comprehend the elements of good chronic disease management, so goes the community. The invested hours of staff education and involvement has lead to the total success of the program. The staff has continued to take a more active role in diabetes management. A single example is blood glucose monitoring. When the program started, patients occasionally got blood glucose checked as part of the visit and only by the RN. With a generous donation from Life Scan over 30 meters have been given to patients in the Hana community. Checking blood glucose is standard protocol for checking in patients and the staff has trained each other and the patients in the use of the home glucose monitoring.

The operation of the video conferencing has had a similar course. With the introduction of the video conferencing, selected staff has learned to use the equipment. The equipment has been used to communicate with the staff and they have been encouraged to get other staff involved. Even though there has been staff turnover, the knowledge of the use of the equipment and the comfort at video conferencing has been continued. It is again a combination of the system change and the development of an inclusive team in the program including the video conferencing.

The use of the rapid change model has avoided being fixed on the initial concepts of the use of video conferencing. The program was initially conceived to support the primary care provider at the Hana Community Health Center and follow-up stable patients. The recruitment efforts have been difficult and the staff and patient feed back has demonstrated that long term follow-up visits are not acceptable in this community at this time. Through analysis of no-shows and re-scheduled visits for telemedicine days and listening to the comments of the staff and patients, the telemedicine visits are no longer scheduled for planned stable visits. Clearly, patients who are stable with limited need for physician contact prefer live planned visits. Medical necessity has lead to the use of the video conferencing for the acute and unstable patients. Video conferencing is frequently used with the dynamic or unsteady patient who requires frequent follow-up. Weekly follow-up is either accomplished over the video conferencing or co-managed with the locums.

Conclusion:

The use of telemedicine to improve specialty care in rural communities has had limited success for a number of reasons. The Hana Diabetes Program is effectively using telemedicine to improve care by using technology to enhance changes in the health care delivery system. Rather than attempting to use telemedicine in the traditional format of a consultation, but rather as an integral part of a program that emphasizes patient centered care, team work and systems changes the telemedicine component of the program is a vital and viable component to the larger program. Telemedicine frequently adds direct cost to the health care system. In the Hana Diabetes Program, the telemedicine costs are justified by the development of measures that clearly show increased quality. The second important component in sustaining the program is having the consultant paid by the health center rather than billing directly for the telemedicine services. Part of the system change for improved health care requires aligning incentives. This compensation package does not fractionate the telemedicine from the rest of the program.

Telemedicine as an IS implementation problem: comparison of dynamics in the USA and India

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Abstract: The research reported here involved a longitudinal study, lasting three years, of the utilisation of an IS system designed to enhance the quality and accessibility of healthcare for the US military and their dependents. This study employed elements of a positivist methodology and an intensive research method. A discussion of the difficulties and conflicts inherent in multi-methodological studies is presented.

Findings indicate that low utilisation rates arose from a cultural mind set mismatch. This is compared to findings in India concerning the implementation of GIS systems [1]. The mismatch was between the cultural variables conducive to organisational learning found in the implementing organisation. The Primary Care Clinic yielded low organisational learning cultural variables that were non-conducive to rapid adoption of the new and intrusive IS technology.

Keywords: Telemedicine implementation; organisational learning; organisational culture.

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1 Introduction

This research involved a longitudinal study lasting nearly three years from Spring 1997 to Autumn 1999. During this period the authors played varying roles as researchers starting as 'independent observers' and slowly migrating to the role of action researchers. The project under study was the Theater-Telemedicine Prototype Project (T2P2). This project was an IS system which was part of a five year, 100 million dollar Department of Defense (DoD) initiative to employ modern IS and telecommunications technology to

enhance the accessibility and quality of healthcare for servicemen and women and their dependents worldwide.

The Theater Telemedicine Prototype Project (T2P2) was a desktop multimedia e-mail medical consultation system that enabled healthcare providers to solve 'real-life' patient care problems across the widely distributed Pacific region. T2P2 was designed with a strong focus on clinical usability and benefited from the ongoing review and consultation of clinical practitioners in the field. It used web-based technology, integrated with medical peripheral devices, to extend medical specialist expertise to isolated locations throughout Hawai'i, Alaska, Korea and other remote islands. T2P2 was a product of the Department of Defense's Pacific Regional Program Office (PRPO) located at Tripler Army Medical Center on Oahu in Hawai'i.

Historically when a healthcare provider practising in a remote area encountered a patient condition that required the input of a specialist, the patient had to be evacuated to a major metropolitan area for specialist consultation. This practice extended the time before the patient could be treated and was extremely costly. T2P2 was a way to eliminate unnecessary medical evacuations (medevacs).

T2P2's initial definition and design began in May 1997. PRPO began assessing needs for telemedicine in the Pacific by evaluating the nature and distribution of medevacs across the region. A clinical team reviewed years of medical and logistical records to determine which sub-specialisms of care (e.g., cardiology, dermatology, orthopaedics), most often necessitated a medevac. Additionally, the referral patterns within each sub-specialism were evaluated to identify the specific medical conditions most likely to be encountered.

Following this initial assessment, efforts focused on the definition of clinical 'protocols' to identify the specific medical information, lab tests, physical examinations and patient symptoms necessary to diagnose medical conditions effectively. These protocols formed the basis of the data design for T2P2.

T2P2 integrates emerging technologies with legacy medical system data to provide a comprehensive environment supporting the clinical consult. Patient information and test results were first imported from the Department of Defense's Composite Healthcare System (CHCS) and from Veteran's Affairs VistA hospital information systems. This information was then supplemented with clinical diagnostic input to pinpoint the patient's specific problem area. Finally, medical imagery components, with digital input devices and radiological images, acted as the remote 'eyes' for distant specialists. All of these components were integrated to yield a comprehensive text appended image look at a patient.

Although each clinical intervention was unique to that particular patient, a typical T2P2 clinical scenario occurred according to the following example:

- A patient enters the clinic at a remote village in Alaska complaining of a troublesome lesion on the back.
- The local primary care giver (general practitioner) believes that there is probably no cause for concern but would like confirmation from a dermatologist. Unlike previous years, it is not necessary to evacuate the patient to Anchorage in order to consult with the dermatologist. T2P2 provides the means, directly from the doctor's desk.

- The doctor launches the T2P2 application using a web browser, enters the patient's identifying information and is immediately provided with information from the patient's medical record, including any recent laboratory studies or x-rays.
- The doctor examines the patient, following the instructions in T2P2's clinical format and provides specific medical history and physical exam information requested by the consulting specialist.
- The doctor takes several digital photographs of the lesion from a number of angles (as outlined in T2P2's help system). These pictures are integrated into the electronic consult.
- When ready, the doctor dials (possibly using an ISP) into the central, specialist site capable of supporting a dermatological consult. The consult and its associated data are encrypted to ensure patient confidentiality and transmitted to the specialist site.
- The dermatologist reviews the material submitted and is able to render an opinion, confirm the diagnosis and make critical treatment recommendations, all without moving the patient from his or her village.

T2P2 was deployed and served patients' needs at Tripler Army Medical Center and Schofield Barracks on Hawai'i by providing dermatology and orthopaedic support. Additionally, T2P2 software was used at medical readiness exercises around the Pacific Rim. Other clinical formats included: Generic Internal Medicine and Ear-Nose-and-Throat (ENT).

T2P2 began to have a profound impact both within and beyond its original target environment. It began to improve patient care and reduce unnecessary costs for DoD in Hawai'i and was set for expansion to a wide variety of locations. T2P2 was scheduled for deployment to Coast Guard facilities, Veterans Affairs (VA) clinics and Indian Health Service clinics in Alaska. The VA was also considering deploying T2P2 for teleconsults at many of its remote clinics across continental USA. Finally, T2P2 was being reviewed for inclusion into DoD's enterprise-wide health information system's modernisation program, Composite Healthcare System II (CHCS II) and Government Computerised Patient Record (GCPR) efforts.

T2P2 was providing qualitative and quantitative benefits to patients and to the healthcare enterprise. It made sophisticated medical specialist care immediately available early in the clinical process to facilitate informed referral decisions.

2 Methods

2.1 The initial research design

We began with a positivistic approach to the study, administering a survey to a selection of healthcare professionals (HCPs) involved in the initial T2P2 demonstration at Schofield Barracks and TAMC. Our aim was to measure the impact that the introduction of telemedicine had on a complex organisation such as the military. We intended to perform 'before and after' surveys book-ending the introduction of T2P2. After administering the first survey, we serendipitously encountered the study conducted by Walsham and Sahay [1] documenting the implementation of a GIS system into provincial

governments in India. Walsham and Sahay utilised the intensive research method that involves the researchers directly in the study as 'action researchers'. Walsham and Sahay discuss actor-network theory in their paper and strongly recommend organisations to make use of the theory when attempting to implement something such as an IS system. Interestingly, the developers of T2P2 had designed the system as if they were following the recommendations of actor-network theory, when actually they were not familiar with the theory. Lee [2] reminds us that scientific research intended for practical application often produces results and conclusions that are already known to the practitioners and in common use, simply without having been scientifically defined. For example:

> " ...When Kepler studied the optimum dimensions of wine casks, the proportions which would yield maximum content for the least consumption of wood, he helped to invent the calculus of variations, but existing wine casks were, he found, already built to the dimensions he derived." [2]

Likewise, T2P2 was already designed to the recommendations of the actor-network theory, before the Walsham and Sahay paper was published. This coincidence caught our attention and interest and because we too were studying the implementation of an IS system, we chose to follow suit and augment our positivistic elements of the study with the more qualitative observations of the intensive research study.

3 The adopted research design

The study was designed to measure the impact that telemedicine may have organisationally. This effort had two functions:

1 assessing the impact on the organisation which occurs as a consequence of the introduction of telemedicine technology into a complex organisation

2 identifying and assessing the organisational factors, which if effectively pre-positioned, will minimise the resistance and maximise the acceptance and utilisation of telemedicine technology.

To assess the organisational impact of the introduction of telemedicine technology, healthcare professionals were evaluated at three different levels: individual, group and organisational. For the individual level, the research teams utilised a survey that measured cognitive perceptions of the caregivers' job characteristics. This survey was to be administered before, during and three months after the introduction of telemedicine. At the group level, the research team chose to measure the medical decision-making process and adopted the qualitative research methodology of ethnography as the operative tool. Thus, through observation and interview, the research team studied medical decision making. At the organisational level, a survey was administered which assessed organisational learning and was to be administered with the same regimen as the job characteristics survey. The variables measured by the organisational learning survey helped to detect changes in the organisation's culture as a consequence of the introduction of telemedicine. Thus, the dependent variables were divided into three broad categories: Job Characteristics, Decision making Loci and Structure and Organisational Culture and Learning.

3.1 Dependent variables

1 *Job task characteristics* – implementation of a telemedicine system is an extraordinarily complex endeavour. The key is the early involvement of the users in its design because their lives will be impacted by the adoption of the technology in their daily activities. Successful implementation requires that individuals learn new ways of thinking about their job tasks. This learning process involves unscrambling old procedures and attitudes, moving to a new pattern and then cementing this new process into the procedures of the individual and groups. The survey of job task characteristics was chosen to assess variation on this variable.

Measurement tool: job characteristics survey. This survey consisted of statements that describe the healthcare professional's subjective cognitive view of the task characteristics of his her job: i.e. the patient care aspects of the job of the healthcare professional [3].

2 *Decision making loci and structure* – telemedicine systems may change patterns of communication and decision making within the organisation. Indeed, the use of telemedicine is a new form of communicating within the organisation. As a consequence, the primary care physicians may wish to involve the expertise of specialised colleagues more often in their medical decision making. HCP may also alter their classification of cases from routine to non-routine or vice versa for other reasons to be determined.

Measurement tool: field observations with interviews. Observations were carried out on a daily basis for a five-month period. During the observation period, short, informal, semi-structured interviews were done with HCPs as appropriate. These interviews and observations were used to probe HCPs' interactions with the telemedicine technology and each other and to note their actions. Approximately 50 HCPs were in the pool of observed subjects. Interviews were initiated as a consequence of observing behaviours that appeared to shed light upon the underlying dynamics of the telemedicine implementation. Interview and observation journals were kept to record results.

3 *Organisation culture and organisational learning* – the impact of a new technical subsystem, such as a telemedicine subsystem, has ramifications not only for the micro-level of the social subsystem of the organisation, on the people and the dynamics of person to person interaction, but also may have ramifications for the macrolevel of the social subsystem of the organisation such as the organisational culture and the organisation's capacity to learn and adapt. In particular, the introduction of a change in the technical subsystem may result in changes in the organisation's culture with regard to the organisation's propensity to learn.

Many factors affect an organisation's propensity to learn: leadership style, openness in communication, direction of that communication (i.e., top-down, bottom-up), the degree to which different areas of the organisation view themselves as connected to other areas, the willingness to recognise shortcomings and the willingness to try new things.

Measurement tool: organisational culture and learning survey. This survey consisted of seven questions designed to determine the culture and disposition for organisational learning exhibited at Schofield and Tripler [4]. This survey measured the change in the HCPs' perception of their respective organisations' culture and learning propensity. These seven measures or factors are:

Factor 1: involvement by leadership

Leadership at all organisational levels articulates a vision and actively works to implement that vision. Leaders take a 'hands-on' approach to educating others about goals and implementing steps to reach those goals.

Factor 2: openness in organisations' climate

Information that will help us do our jobs better is available. We have relatively open boundaries among units. There are opportunities to observe others. Problems and errors are shared, not hidden. Debate and conflict are acceptable.

Factor 3: interdependence among organisational units

Our organisation focuses strongly on the interdependence among our units. We seek to optimise organisational goals at all organisational levels. We see problems and solutions systemically, i.e. how they affect the entire organisation.

Factor 4: support for continuing education

Our organisation has an ongoing commitment to continuing education at all levels. All employees are expected to develop and grow professionally.

Factor 5: willingness to recognise gaps between desired and actual performance

There is a willingness by all employees (from supervisors to healthcare professionals to staff) to recognise any gaps between desired performance and actual performance. We consider performance shortfalls to be opportunities for learning and organisational improvement. The organisation is continually trying to improve.

Factor 6: diversity in sources for initiatives for change and learning

Initiatives for change and learning may be top-down or bottom-up. People from various areas and of differing status within the organisation may recommend and evaluate initiatives for change and learning.

Factor 7: support for trying new things

Our organisation supports an experimental mindset. Employees are invited to 'play' with things. Failure is viewed as an opportunity to learn and improve, not simply as a negative. We are often experimenting with gradual changes in work processes, policies and structures.

It must be mentioned that our main objective was to identify the dynamics of the introduction of telemedicine and not to act as an agent that facilitates successful implementation of this telemedicine pilot program. However, this was, at times, a difficult tightrope to walk, especially with regard to organisational issues, since expertise in the area of organisational readiness was clearly needed as the project began its pilot study. Thus, as the study progressed, it became clear to us that we could obtain more

insight and understanding of the dynamics of the telemedicine implementation through an action research methodology and further, if we did not take on the role there was a significant likelihood that we would be seen as non-cooperative by the HCPs, thereby eliciting a backlash of non-cooperativity from the study's subjects.

4 Results

Healthcare professionals were evaluated at three different levels: the individual, group and organisation level. Surveys at the individual level measured how individuals are thinking about their present job tasks. Observation and interview were conducted at the group level and a survey was administered at the organisational level, which assessed organisational learning. The quantitative surveys were administered before the introduction of the telemedicine system. Qualitative data at the group level was collected shortly after its implementation and for a period of five months thereafter.

4.1 Pre-implementation survey (individual level) – quantitative

A total of 23 healthcare professionals were surveyed (Table 1); five specialist physicians, six primary care physicians, eight nurses and physician assistants combined and four medical technicians.

Table 1 Summary of the number of individual level surveys administered for both the individual and organisational level analyses

	Healthcare Professional			
Healthcare Factor 5	*Specialist Physicians*	*Primary Care Physicians*	*Nurses/Physician Assistants*	*Medical Technicians*
Schoffield	0	6	8	4
Tripler	5	0	0	0
Total	5	6	8	4

Figure 1 outlines the sequence of events for the study surrounding the implementation of the telemedicine system. Preliminary baseline surveys were administered followed by two, two-day workshops. Once T2P2 was implemented, observations and group interviews were conducted.

Figure 1 Timeline highlighting key events during the course of the study

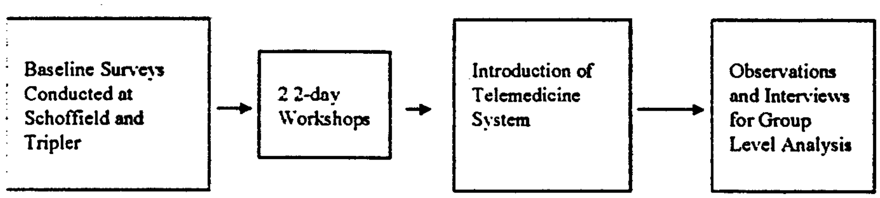

Table 2 shows the initial results of the Job Characteristics Survey used to measure cognitive perceptions of the caregivers job characteristics. This survey was conducted prior to the implementation of the telemedicine system and yields three measures of the perceived meaningfulness of the work: skill variety, task identity and task significance. one measure of the individual's perceived responsibility and autonomy and one measure of perception of job feedback. These measures are predictors of how well individuals learn new ways of thinking about their job tasks and their ability to replace old procedures and attitudes with new ones. Four groups of healthcare professionals (primary care providers. specialist care providers. nurses and medical technicians) were surveyed using a five-point scale from −2. indicating strong disagreement. −2 indicating strong agreement as the most desirable job task characteristic. Mean scores were all above neutral (0) and only a few scores were less than one. Positive scores indicate agreement with the notion that their job task offered them that particular measure. Negative numbers indicate a lack of agreement.

Table 2 Mean scores from caregivers of cognitive perceptions and desirability of job characteristics

		Specialist Physicians	*Primary Care Physicians*	*Nurses/ PAs*	*Medical Technicians*
Meaningfulness	Skill Variety	1.33	1.11	1.42	1.21
	Task Identity	1.20	1.00	1.75	0.91
	Task Significance	1.53	1.56	1.58	125
Responsibility	Autonomy	1.20	1.06	1.25	0.83
Feedback of Results	Job Feedback	0.80	1.11	1.50	0.75
	Overall	1.12	1.13	1.44	0.90

The results and insights from Table 2 are described below.

Specialist care physicians and medical technicians perceive that they do not receive enough feedback about the results of their work (0.8 and 0.75 respectively). The T2P2 system needs to incorporate automatic feedback for specialist physicians and medical technicians. Also. feedback and reinforcement should be given for the utilisation of telemedicine and for the innovation of new applications used in the telemedicine system. This may be done by simply automating an e-mail response whenever a telemedicine treated patient's computerised medical record is accessed.

Medical technicians indicate that they are unsure of their 'job title' and have trouble identifying their exact role (0.91). This gives them the impression that their work is less meaningful. Medical technicians need to be more versatile. broadening job tasks so they feel they are playing a significant role and achieve a sense of meaningfulness as part of the telemedicine system.

Medical technicians also perceive they do not have enough autonomy for scheduling tasks and determining procedures (0.83). As part of the introductory training and continuing education for telemedicine. medical technicians need to be given more responsibility and autonomy in ways that safely enhance the quality of information transferred via T2P2.

These results provide a baseline of information for later comparison to results following the implementation of the telemedicine system. However. these results provide

useful information for intervention and facilitating the implementation of T2P2. The implementation of T2P2 requires individuals to learn new concepts and new ways of thinking about their job tasks.

4.2 *Administration of the organisational culture and learning survey (organisational level) – quantitative*

Seven measures of the organisation's culture for the propensity to be a learning organisation were carried out on four groups of healthcare professionals. These baseline data are very useful for the development of insights concerning the planning of process reengineering and organisational interventions designed to enhance the probability of success of future DoD telemedicine interventions. A survey instrument administered concurrently with the job characteristic survey measures the organisation climate, culture and capacity to learn and adapt. A score of seven represents the highest judgement contribution to learning organisations and a greater inclination towards organisational learning. Low scores represent low perception of contribution (Table 3).

Table 3 Initial organisational culture and learning survey results

	Specialist Physicians	*Primary Care Physicians*	*Nurse/Physician Assistants*	*Medical Technicians*
Involvement by leadership	5.50	4.75	5.25	6.13
Openness	4.80	4.20	4.68	4.63
Interdependence	4.70	3.67	4.56	5.88
Support for continuing education	6.00	3.58	4.60	3.75
Acknowledge performance gaps	4.70	4.00	5.06	5.00
Diversity of initiatives	4.40	3.83	4.87	5.00
Support new things	5.10	3.50	4.90	4.50

Overall, only five instances scored below four, at less than moderate agreement and four of these were by primary care physicians. That is, primary care physicians indicated the five dimensions (interdependence (3.67), continuing education (3.58), performance gaps (4.0), diversity (3.83) and innovation (3.50)) of organisational learning to be low. Scores were significantly less than for other healthcare professionals (Fisher Test for small samples, $p \leq .05$). Specialist care physicians are more likely to define their organisational culture as a learning organisation than the primary care physicians are. And lastly, medical technicians felt a lack of support for their continuing education (3.75).

These baseline data reveal the necessity for the telemedicine system design to incorporate a continuing education program both prior to and during the implementation efforts. The programs must teach technical skills as well as enhance professionalism giving opportunity for higher levels of responsibility.

There is a strongly perceived need by the medical technicians for greater opportunity for continued education.

Table 4 reveals how only seven of the potential ten physicians used a telemedicine consult. Of these seven, only five used a telemedicine consult more than once over the two-month period.

Table 4 T2P2 utilisation rates by primary care physicians, November and December 1999

Primary Care Physicians	*Ortho. T2P2 consults: Nov - 99*	*Ortho. T2P2 consults: Dec - 99*	*Derm. T2P2 consults: Nov - 99*	*Derm. T2P2 consults: Dec - 99*
Dr. A	0	0	0	3
Dr. B	0	0	2	0
Dr. C	0	0	0	0
Dr. D	2	0	1	0
Dr. E	1	0	0	0
Dr. F	0	0	1	1
Dr. G	0	0	0	0
Dr. H	1	0	0	2
Dr. I	0	0	0	0
Dr. J	0	0	0	1
Totals	4	0	4	7

In the two specialisms implemented by T2P2 (orthopaedics and dermatology), during the two month period, only 15 patients were referred to a T2P2 consult in both specialisms when as many as 40 were anticipated.

4.3 *Observations and interviews with HCPs (group level) – qualitative*

Qualitative formal and informal interviews were conducted with the participating healthcare professionals to probe interactions with the telemedicine technology and each other and to note their actions. Both positive and negative themes emerged from these observations and interviews. The objectives were to understand better the attitudes of healthcare professionals during the early stages of the telemedicine implementation that may be informative for encouraging further use of the technology.

Observations and interviews highlighted certain successes and failures visible in these early stages of T2P2 implementation. These are described below and summarised in Table 5.

Table 5 Set of themes highlighted during interviews and observations with healthcare professionals

Healthcare Professional	*Theme*
Specialist physician	– Credit not received for consult since policy requires patients to be physically present with the specialist
Primary care physician	– Enhanced quality care by using a referral that would not have normally been used – Physician learns from the specialist – Excessive workload not being credited – Need to have technical experts available at all times to ensure proper working of all hardware and software
Nurse/physician assistant	None
Medical technician	– Medical technicians given a limited amount of autonomy can contribute significantly to the quality of healthcare
All healthcare professionals	– A desire for continuing education with the proper education programs in place

A medical technician was observed taking photos of a paediatric patient, describing the technique to another member of staff, the patient and the patient's parents. The parents, patient and staff member were impressed by the rapid processing and quality of the photos. This limited autonomy shows how medical technicians can contribute significantly to the quality of healthcare without superceding physician instruction.

A medical technician was being trained on how to use the digital camera. During the training, a second medic began to observe and requested the scheduling of a training session for himself. This evidence demonstrates the desire for continuing education of healthcare professionals and the importance of having education programs in place prior to the implementation of telemedicine and continuously throughout.

One physician noted that he would not have sent some patients to a specialist for referral if it were not for T2P2. Therefore, there is potential for enhanced quality of care through better communication with specialists. Two benefits arise here. The patient gets better quality care and the physician learns from the specialist, improving her/his medical skills. During readiness training, potential for new learning and professional enhancement should be emphasised.

Primary care physicians expressed unrecognised, excessive workload as a major concern. During a telemedicine consult, they spent two sessions with the patient, one before and one after the digital data collection. However, DoD procedures did not allow credit for a second visit with the same patient in the same day. Therefore it appeared as if they were seeing fewer patients a day. Not crediting extra effort by physicians impacted the amount of utilisation of the system (Table 4).

The specialist physician did not receive full workload credit for T2P2 consults because DoD policy requires patients to be physically present with the specialist in order to receive full workload credit. It is critical that DoD workload policy be amended to accommodate users and consults of telemedicine. When a new system is being piloted, there needs to be some flexibility in the current protocols in order to give the system a fair chance.

Primary care physicians expressed a need to have on-the-scene technical experts available at all times to ensure proper working of all hardware and software, as well as technical assistance should it be needed. This would also enable immediate problem-solving preventing escalation of problems out of control.

Primary care physicians, during interviews, indicated that a strong T2P2 would be very significant in its ability to offer them opportunities for new learning and professional development. Primary care physicians sometimes received advice from specialists where otherwise they would not have done so.

5 Utilisations of T2P2

The primary care physicians identify their organisation as having low organisational learning cultural characteristics. Thus, the propensity for rapid adoption of new technologies, such as store and forward telemedicine, is lower than might be ideally the case. Observation of utilisation rates of the T2P2 system during its early months of implementation justified this concern. Table 4 above yields the utilisation of T2P2 during the two-month period, November and December 1999. Observation of results yielded in Table 4 shows that only seven of the potential ten physicians used a telemedicine consult

and of the seven users, only five used a telemedicine consult more than once over the two-month period.

In a primary care clinic seeing large numbers of patients each week in the two specialisms implemented by T2P2 (orthopaedics and dermatology), over the two-month period, only 15 patients were referred to a T2P2 consult in both specialisms. It had been anticipated by program managers that as many as 40 dermatology and orthopaedic consults each might be processed over the two months by telemedicine.

Correlation of Table 3 and Table 4 appears not to support the null hypothesis that organisational learning propensity within an organisation's culture is unrelated to the propensity of an organisation to utilise a new technology such as T2P2. Put in more common terms, our findings are that the lack of an organisational culture supportive of learning is associated with lower than expected utilisation rates of a newly introduced telemedicine technology, such as T2P2.

Drawing from the wisdom of Organisational Learning Theory, the shortfall between expected performance and actual performance needs to be considered an opportunity for learning and organisational improvement. At the orientation for T2P2 at the Primary Care Clinic, each physician was given a half-day training program that emphasised the technical aspects of T2P2 usage. There was no coherent effort to enhance the organisational culture to be more ready to adopt a new technology. Rather, it was assumed that all would fall in, salute and use the system appropriately.

Most organisational behaviour specialists would argue that an effective program designed to develop an organisation with stronger organisational learning cultural propensities is a significant undertaking and in most cases would require a number of full day workshops spaced over several months to allow time for the new cultural values to set in and stabilise. Many in the Primary Care Clinic and PRPO office including its leadership of both would have endorsed such a program, but the realities of the busy schedule at the Primary Care Clinic appeared to rule out the major effort to ready that organisation culturally for telemedicine implementation. There was no other continuing education or development activity of this sort undertaken at the Primary Care Clinic. Our assessment of the degree of Positive Organisational Learning capacity indicates to us that such a program was definitely called for in this case.

6 Organisation structure and policy issues

Here the workload measurement system must be highlighted. The current DoD measurement for workload does not allow the same patient to be seen by the physician twice in one day. Yet, the procedure for using the T2P2 telemedicine consult at this prototype site required such dual visits, one before and one after the necessary digital data collection. At the Primary Care Clinic, all sorts of imaginative approaches to the scheduling of patients were invented to overcome this dilemma. However, observations and interviews at the clinic indicated that many physicians opted not to use T2P2 when appropriate and the workload measurement issue may be a key reason for this lower than expected utilisation.

Organisational learning issues

On a more positive side, results of interviews with primary care physicians indicated a strong belief that T2P2 will be very significant in its ability to offer the primary care physician opportunities for new learning and professional development. Many times, T2P2 was used by primary care physicians to seek advice and guidance from specialists in cases where the primary care physician usually diagnosed and treated the patient without such specialist physician input. This is a very optimistic sign because not only does it demonstrate one of the key advantages of implementing store and forward telemedicine systems, but it is also a strong force in encouraging higher utilisation rates among the initiating primary care physicians.

8 Premature cancellation of the evaluation

In early 2000, the low utilisation rates in the T2P2 demonstration project were obvious to all involved. Clinical nurses involved in the project management argue that the main reason for low utilisation was the fact that the demonstration project was being evaluated. They reasoned that the evaluation requirement of randomly selecting only one half of eligible T2P2 candidates for actual T2P2 processing, required by the experimental design of the evaluation study, had the effect of cutting utilisation rates in half.

Whilst true, it is also true that the pre-study predictions of expected utilisation rates were eight times greater than those observed. Thus, the evaluation project was clearly one, but not the only nor the major cause of low utilisation.

Nevertheless, the project manager, also an army nurse, decided to halt all evaluation efforts effective from 1 February, 2000. Thus, the research project herein described was terminated, thereby preventing planned 'post-treatment' quantitative evaluations.

9 Discussion

Walsham and Sahay [1], using an intensive research study approach [5] investigated the level of success in achieving utilisation of a geographic information system (GIS) to aid decision making by district level administrators in India. District level administrators were called upon to administer numerous development activities in India; decisions in education, agriculture, wildlife management and infrastructure development. Many of these decisions were spatial in nature; for example the location of schools, or the planning of roads. The utilisation of a GIS appeared to offer significant benefits to aid these administrators in their district level decisions. Further, the GIS offered the potential to bring about some integration among the decisions across districts such that different administrators would have a common conceptual framework of map-based systems from which they might solve problems.

Despite its significant potential, the research indicates that the GIS was underutilised during the three-year study. A major impediment to utilisation was the lack of aligned interests among the key actors directly involved in the implementation program.

The successful implementation of T2P2 in the healthcare system of the US military, depends on the establishment of a network of actors who are all reasoning and acting in a

similar manner. The actors are both the people and the technology involved. If all parties are not in agreement, the network will fail to develop and the goal will not be reached. For instance, in the Walsham and Sahay study [1] the actors were the people utilising the GIS software, the organisation supervising the people utilising the GIS system, the developers of the GIS software and the software itself. All of these actors had to be thinking or acting within the same set of sociological and intellectual parameters. One of the reasons that the GIS system was not successfully implemented in India was due to objective differences among the key actors. The GIS system was developed by Western technicians; however, it was to be utilised by people from an Eastern culture who valued different goals and approached problems in an intrinsically different fashion.

Walsham and Sahay [1] noted that a key feature of the actor-network theory is that the actors can include both human actors and technological actors, such as the GIS system itself. Thus, embedded within a modern information system are values, goals, methods of inquiry and other particular viewpoints or statements considered to be 'truth' that are most often unintentionally inscribed by the system's creators. These inscriptions are, in most cases, unobtrusive and frozen into codes, electronic thresholds and other system parameters. Because these inscriptions are frozen beneath the surface of the technology, they are rarely accessed for the purpose of examination and/or modification.

Where in the Walsham and Sahay study there was a conflict between Western and Eastern cultures, there can be similar conflicts between professional and academic cultures, or even between separate professional cultures. Thus, analogous to the case in the Walsham and Sahay study [1], the mode of inquiry of a professional culture (i.e. lawyers' or healthcare professionals') is often different from that of academia. We believe that in the T2P2 case, the problem of conceptual non-alignment was avoided by involving healthcare professionals in the development phase of T2P2 so that the system would already be aligned with the interests of the doctors and technicians who were to use it. Thus, we felt our T2P2 study might serve as an interesting comparative analysis to the GIS study.

The results of our study indicate that the IS system studied was not used as frequently as expected, but was, in fact, rarely used. And this low utilisation resulted in the perception of failure by those in charge.

It is our argument that the IS system under study failed not because of different models of inquiry as was proposed by Walsham and Sahay [1] as one cause of failure of the IS system they had studied. The IS system studied here had taken steps to implement the operant models of inquiry of its potential users within its structure. Rather, we propose that the system failed primarily because the organisation selected to use it was not adequately prepared educationally, attitudinally and structurally. This does not imply that the 'models of inquiry' issue raised by Walsham and Sahay [1] is not relevant or important in IS implementation work, but only that its impact was not a significant variable in our study.

Educationally, a program of organisational cultural intervention to create a more 'learning friendly' culture was necessary. Attitudinally, the leadership of the implementing organisation needed to value the successful high utilisation of the IS system as one of its primary organisational goals. Structurally, the in-house reward structure and incentive system of workload credit needed to be modified before IS implementation such that the system utilisation would be reinforced by incentives rather than discouraged by the existing incentive system.

References

1 Walsham, G. and Sahay, S. (1999) 'GIS for district-level administration in India: problems and opportunities,' *MIS Quarterly*, March, Vol. 23, No. 1, pp.39–65.

2 Lee, A.S. (1999) 'Rigor and relevance in MIS research: beyond the approach of positivism alone,' *MIS Quarterly*, March, Vol. 23, No. 1, pp.29–33.

3 Sims, H.P. Jr., Szilagyi, A.D. and Keller, R.T. (1976) 'The measurement of job characteristics', *Acad. of Mgt. J.*, Vol. 19, pp.195–212.

4 DiBella, A.J. and Nevis, E.D. (1998) *How Organisations Learn: An Integrated Strategy for Building Learning Capability*, Josey-Bass, San Francisco, CA.

5 Weick, K. (1984) 'Theoretical assumptions and research methodology selection', in F.W. MacFarlan (Ed.) *The Information Systems Research Challenge*, Harvard Business School Press, Boston, Mass., pp.111–129.

Bibliography

Adams, L. and Grigsby, R.K. (1995) 'The Georgia state telemedicine program: initiation, design and plans', *Telemed J.*, Vol. 1, No. 3, pp.227–235.

Applegate, L.M., McFarlan, F.W. and McKenney, J.L. (1996) *Corporate Information Systems Management*, Irwin, Chicago.

Applegate, L.M. and King, J.L. (1999) 'Rigor and relevance: Careers on the line', *MIS Quarterly*, March, Vol. 23, No. 1, pp.17–18.

Bashshur, R.L. (1995) 'Perspective: on the definition and evaluation of telemedicine', *Telemed J.*, Vol. 1, No. 1, pp.19–29.

Benbasat, I. and Zmud, R.W. (1999) 'Empirical research in information systems: the practice of relevance', *MIS Quarterly*, March, Vol. 23, No. 1, pp3–16.

Beyer, J.M. and Trice, H.M. (1982) 'The utilisation process: a conceptual framework and synthesis of empirical findings', *Administrative Science Quarterly*, Vol. 27, pp.591–622.

Bostrom, R.P., Olfma, L. and Sein, M.K. (1990) 'The importance of learning style in end-user training', *MIS Quarterly*, March, Vol. 14, No. 1, pp.10–119.

Calcagni, D.E., Clyburn, C.A., Tomkins, G., Gilbert, G.R., Cramer, T.J., Lea, R.K., Ehnes, S.G. and Zajtchuk, R. (1996) 'Operation joint endeavor in Bosnia: telemedicine systems and case reports', *Telemed J.*, Vol. 2, No. 3, pp.211–221.

Churchman, C.W. and Schainblatt, A.H. (1965) 'The researcher and the manager: a dialectic of implementation', *Management Science*, Vol. 11, No. 4, pp.B69–87.

Creswell, J.W. (1998) *Qualitative Inquiry and Research Design: Choosing Among Five Traditions*, Sage Publications, Inc., Thousand Oaks, CA.

Daft, R.L. and Lewin, A.Y. (1990) 'Can organisation studies begin to break out of the normal science straightjacket? An editorial essay', *Organisation Science*, Vol. 1, No. 1, pp.1–9.

Davenport, T.H. and Markus, M.L. (1999) 'Rigor vs. relevance revisited: response to Benbasat and Zmud,' *MIS Quarterly*, March, Vol. 23, No. 1, pp.19–23.

Doktor, R.H. and Hamilton, W.F. (1973) 'Cognitive style and the acceptance of management science recommendations,' *Management Science*, Vol. 19, No. 8, pp.884–894.

Fillingham, L.A. (1993) *Foucault for Beginners*, Writers and Readers Publishing, Inc., New York, NY.

Gerlach, J.H. and Kuo, F. (1991) 'Understanding human-computer interaction for information systems design', *MIS Quarterly*, December, Vol. 15, No. 4, pp.526–549.

Golden-Biddle. K. and Locke, K. (1993) 'Appealing work: an investigation of how ethnographic texts convince', *Organisation Science*, Vol. 4, No. 4, pp.595–616.

Hitt, M.A., Keats, B.W. and DeMarie, S.M. (1998) 'Navigating in the new competitive landscape: building strategic flexibility and competitive advantage in the 21st century', *The Academy of Management Executive*, Vol. 12, No. 4, pp.22–42.

Huysmans, J.H.B.M. (1970) *The Implementation of Operations Research*, Wiley-Interscience, New York, NY, pp.1–43.

Keen, P.W. (1980) 'MIS research: reference disciplines and a cumulative tradition', in E. McLean (Ed.) *Proceedings of the First International Conference on Information Systems*, Philadelphia, PA, pp.9–18.

Keen, P.G.W. (1981) 'Information systems and organisational change', *Communications of the ACM*, Vol. 24, No. 1, pp.361–373.

Kieras, D. and Poison, P. (1985) 'An approach to the formal analysis of user complexity', *International Journal of Man-Machine Studies*, Vol. 22, pp.365–394.

King, J.L. and Applegate, L.M. (1997) 'Crisis in the case study crisis: marginal diminishing returns to scale in the quantitative-qualitative research debate', in A.S. Lee, J. Liebenau and J.I. DeGross (Eds.) *Information Systems and Qualitative Research*, Chapman and Hall, London, pp.28–30.

Klein, H.K. and Myers, M.D. (1999) 'A set of principles for conducting and evaluating interpretive field studies in information systems', *MIS Quarterly*, March, Vol. 23, No. 1, pp.67–93.

Latour, B. (1987) *Science in Action: How to Follow Scientists and Engineers Through Society*, Harvard University Press, Cambridge, MA.

Leavit, H.J. (1965) 'Applying organisational change in industry: structural technological and humanistic approaches', in J.G. March (Ed.) *Handbook of Organisations*, Rand McNally, Chicago, IL, pp.1144–1170.

Lemert, C. (1997) *Postmodernism is Not What you Think*, Blackwell Publishers, Malden, MA.

Levine, L. and Mohr, B.J. (1998) 'Whole system design (WSD): the shifting focus of attention and the threshold challenge', *The Journal of Applied Behavioral Science*, Vol. 34, No. 3, pp.305–326.

McKenney, J.L. and Keen, P.G.W. (1974) 'How managers' minds work', *Harvard Business Review*, Vol. 52, No. 3, pp.79–90.

Nadler, D.A. and Tushman, M.L. (1990) 'Beyond the charismatic leader: leadership and organisational change', *California Management Review*, Vol. 32, No. 2, pp.77–97.

Nevis, E.C., DiBella, A.J. and Gould, J.M. (1995) 'Understanding organisations as learning systems', *Sloan Management Review*, Winter, Vol. 36, No. 2, pp.73–85.

Orlikowski, W.J. (1993) 'CASE tools as organisational change: Investigating incremental and radical changes in systems development', *MIS Quarterly*, September, Vol. 17, No. 3, pp.309–340.

Puskin, D.S., Morris, T., Hassol, A., Gaumer, G. and Mintzer, C.L. (1997) 'Patient and provider acceptance of telemedicine', *New Medicine*, pp.55–59.

Robey, D. (1996) 'Diversity in information systems research: threat, promise and responsibility', *Information System Research*, Vol. 7, No. 4, pp.400–408.

Sanders, J.H. and Bashshur, R.L. (1995) 'Challenges to the implementation of telemedicine', *Telemed J.*, Vol. 1, No. 2, pp.115–123.

Satzinger, J.W. and Olfman, L. (1998) 'User interface consistency across end-user applications: the effects on mental models', *Journal of Management Information Systems*, Spring, Vol. 14, No. 4, pp.167–193.

Schein, E.H. (1965) 'Organisational man and the process of management', in E.H. Schein (Ed.) *Organisational Psychology*, Prentice-Hall, Ind. Englewood Cliffs, NJ, pp.43–65.

Schultz, R.L. and Slevin, D.P. (1979) 'Introduction: the implementation problem', *Studies in the Management Sciences*, Vol. 13, pp.1–15.

Senge, P.M. (1990) *The Fifth Discipline*, Doubleday, New York, NY, pp.340–356.

Zmud, R.W. and Cox, J.F. (1979) 'The implementation process: a change approach.' *MIS Quarterly*, Vol. 3, No. 2, pp.35–43.

Zmud, R.W. (1996) 'Editor's comments,' *MIS Quarterly*, September, Vol. 20, No. 3, pp.xxxvii–xxxviii.

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Preparing Healthcare Professionals for Telemedicine: Results from Educational Needs Research

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ABSTRACT

As part of an overall research program to create a set of web-based interactive distance learning modules, an educational needs assessment was conducted. The educational needs assessment is undertaken to collect information via observation and interview as to which knowledge areas are most desirable for incorporation into the interactive distance learning modules. This research is best undertaken with a neutral stance and without any preconceptions or hypotheses as to which knowledge areas are likely to be most useful. The interactive modules were designed to enhance the utilization of telemedicine by health care providers. This paper is a report on the methodology used and the findings of the needs assessment. The educational needs assessment acts as a compass to guide the creation of curricula. In the design of interactive learning, the needs assessment may be an important tool that informs not only the selection of the content, but also the selection of technology and courseware processes. The methodology described herein may be useful as a template for other authors of interactive learning courseware. The results of this study identified four clusters of content to be offered and confirmed the selection of interactive, web-based distance learning as the most appropriate delivery approach.

INTRODUCTION

Problems with Telemedicine

The use of telecommunication technology in delivering medical care (telemedicine) has been utilized in the private sector for well over 50 years. Likewise, the US military has been actively working with the use of telemedicine for quite some time. Both sectors have incorporated some aspects of telemedicine into just about every medical specialty. While some

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programs have been successful, many more have been very difficult to implement or considered outright failures.

A major cause of telemedicine failure is low utilization by the healthcare professionals who are expected to benefit from the system. Causes of low utilization can be divided into two broad categories. The first cause is technological and the second is socio-organizational. Technology presents a number of low utilization traps for the organization to fall into:

1. Mismatched technology – when one hospital's equipment is unable to properly communicate with another hospital's, or worst, equipment within the same facility.
2. Outdated technology – where a facility ends up trying to utilize old, slow inefficient systems.
3. Over-reliance – when organizations expect technology, not people, to fill gaps in a poorly-planned project (Davenport & Prusak, 1998).

The common result of these and other technological problems is an underutilized system that gives telemedicine and its adherents a bad reputation and leads to the second cause, socio-organizational problems, which also contributes to telemedicine's low utilization in the following ways:

1. Lack of awareness of the system – lowers utilization because the system is poorly marketed to its potential users.
2. Lack of belief in the system – causes low utilization as doctors believe that telemedicine will not aid them in their diagnosis, preferring the hands-on approach instead.
3. Technophobia – a doctor's fear of the telemedicine system or its potential complexity also leads to low utilization.

Training May Improve Utilization

The first two technological problems, mismatched and outdated technology, are the easiest to fix. With the proper technical personnel, and enough money, these two problems are easily dispatched. Conversely, the third technological problem, over-reliance, and all of the socio-organizational problems are much more difficult to overcome.

Nonetheless, once solved, the solutions offer the most promise in creating an effective telemedicine system. Training is the solution commonly offered to these problems (Blignault & Kennedy, 1999; Calcagni et al., 1996; Forkner, Reardon, & Carson, 1996; Gomez et al., 1996; Levine, Cleary, & Mun, 1998; Walters, 1996).

For the Department of Defense (DoD), and practically every other organization undergoing change, to successfully implement telemedicine, training may help people accept how their jobs and work environments will change.

Training provides an organization the opportunity to address the problems mentioned above. First, training offers healthcare professionals (HCPs) an introduction to the facility's telemedicine system and its proposed benefits. In essence, the training program acts as a marketing tool, increasing the project's name, recognition and communicating its abilities.

Second, training can bridge the gap between an HCP's preconceived notion of telemedicine and its actual efficacy. By showing examples of telemedicine applications in specific specialties, an HCP can become more at ease with telemedicine and understand that telemedicine is not there to replace the HCP but to augment the HCP's abilities.

Third, a combination of books, hands-on training, and mentor training may assist the HCPs to overcome their technophobia. While technology today has the stigma of being 'hard-to-learn', with the proper training techniques, an HCP's level of comfort and understanding of computer software or hardware tools may increase.

Lastly, training is an excellent response to the over-reliance upon technology. Over-reliance need not occur if the three organizational issues mentioned above are addressed. If training is properly executed, the three organizational barriers are brought down and HCPs may accept telemedicine and have meaningful inputs in further applications.

Proper Training Begins with Needs Assessment

The study that follows involves the large-scale introduction of telemedicine into the DoD medical care system. The DoD. like any private sector organization, is likely to feel a significant impact upon its processes at both the micro and macro levels. As mentioned, in order to assuage the dangers of technological as well as socio-organizational transition, a training program should be initiated. To lessen the chance of a poor training program or even a 'false start' with an unsuitable training program. an educational needs assessment is recommended (McArdle, 1998).

The educational needs assessment acts as a compass to guide the creation of the training curricula. Needs assessment attempts to address the issue of who, what, and how to teach the curricula. When done properly. needs assessment fosters a feeling of teamwork and ownership of the curricula. This is because many opinions are taken into account from all over the organization, both

Table 1. Nine Needs Assessment Techniques (Steadham, 1980).

Observation	• Used to distinguish organizational processes either formally or informally
Questionnaires	• Used to collect facts and opinions of the organization
Key consultation	• Used to gain insight from high-level or highly knowledgeable personnel
Print media	• Used to clarify normative needs in the organization's industry
Interviews	• Used to gain in-depth facts and opinions
Group discussion	• Used to support and aid ownership of final suggestions
Tests	• Used to sample outcome of final suggestions
Records & reports	• Used to objectify past successes and failures
Work samples	• Used to give researchers understanding of processes involved

horizontally and vertically. In the educational needs assessment, the effort must be to approach the initial stages with an absolutely neutral stance and no preconceived expectations or theories. This research does not follow the usual scientific positivist approach of hypothesis and then data collection. Rather, it does the opposite, data collection and then theoretical construct formulation. After the initial two stages of the educational needs assessment, the researcher does develop theoretical constructs and these guide the interview process. These constructs are found in our discussion of the survey and structural interview inventory creation.

One limitation about needs assessment is warranted. Though much information is derived from needs assessment, no assessment is able to quantify perfectly the specific requirements for a program. Rather, the needs assessment suggests the probable need and requirements for a program (Soriano, 1995). With this in mind, it is recommended to use a variety of data collection methods. Multiple data sources provide different perspectives of the same data and give more creditability to the resulting analysis (Goldstein, 1986). Table 1 above lists nine basic needs assessment data collection methods.

THE STUDY – THE DOD AND ITS COMMITMENT TO TELEMEDICINE

Telemedicine in the DoD's Mission

The primary mission of US military healthcare system is to ensure and enhance the 'readiness' of US military fighting forces. 'Readiness' is the term

used to describe US military's constant ability to engage an enemy 'anytime, anywhere'. To this end, the DoD has researched many new technologies to augment its readiness. Telemedicine is one such technology.

The DoD regards telemedicine as a discipline that is well worth exploring. Indeed, the DoD entered a research agreement with the University of Hawaii at Manoa to create a telemedicine training curriculum whereby HCPs, both new and experienced with telemedicine applications, can learn about telemedicine and thus breakdown the barriers mentioned previously.

Training and Needs Assessment

The agreement called for the University researchers to use an educational needs assessment in its telemedicine curriculum creation. There were four steps in the needs assessment: Surveillance, the identification of the current situation relative to telemedicine and its training; Investigation, the gathering of data; Analysis, the creation of a picture from the data; and Reporting, the description of the picture (McArdle, 1998).

This needs assessment has an additional benefit to those listed earlier, in that it allows for mid-course changes as needed. This educational needs assessment includes a system of research, course development, instructional delivery, and evaluation that, in-turn, provides more research data, beginning the cycle anew. The cycle continually feeds itself, producing the benefit of steady process improvement.

The organizational change that occurs within a medical care system, military or otherwise, when new technology is introduced is often difficult to anticipate. Telemedicine is a technology of the most intrusive sort. It will change the diagnosis, patient–doctor communication and medical decision-making structure within the DoD's medical care system setting. Therefore, it is imperative that care be taken to make the change occur as smoothly as possible, the first time.

THE DoD'S NEEDS ASSESSMENT OBJECTIVES AND SUBJECTS

Research Objectives

The preliminary objectives of the needs assessment are listed below. These objectives resulted from the collaboration between the University's research team and DoD personnel. This initial collaboration served to create a bond

between the two groups and begin a working relationship. Additionally, it served to create a sense of ownership between the two parties so that, as the project progressed, changes in the assumptions could be openly discussed.

The purpose of this research was to:

- Confirm if telemedicine training is needed by the DoD healthcare providers.
- Determine what are the learning needs of DoD healthcare providers.
- Determine if distance learning methods, would be appropriate for telemedicine training.
- Determine the content of the web-based, interactive learning modules.
- Identify learning modules that have the highest priority.
- Identify learning objectives appropriate for the learning modules with highest priority.

Research Subjects

Observed Programs

The subjects of the University of Hawaii's research were personnel from numerous existing DoD telemedicine projects. During the different stages of the needs assessment, personnel of varying job descriptions and ranks were interviewed and surveyed. Much of the preliminary work for the needs assessment took place at Tripler Army Medical Center (TAMC, Tripler Army Medical Hospital Website) located on the island of Oahu (same as the University of Hawaii at Manoa) in the state of Hawaii. TAMC is presently home to numerous projects that are researching, establishing, and monitoring telemedicine systems in different specialties and locations throughout the Pacific Region. One group in particular, the Pacific Regional Program Office (PRPO, Pacific Regional Program Office Website) is the host organization for seven telemedicine projects that were used at different stages of this needs assessment.

Research performed at TAMC was augmented by surveys of telemedicine personnel in Washington, DC. This subject group contributed facts and opinions related to telemedicine implementation of programs on the East Coast of the United States as well as Europe and Africa. On the East Coast, there were personnel from three major organizations (on the level of PRPO above) interviewed – Telemedicine and Advanced Technology Research Center (TATRC, Telemedicine and Advanced Technology Research Center Website), Multimedia Integrated Distributed Network (MIDN, Naval Medical Research Center Website), and Walter Reed Army Medical Center (WRAMC, Walter Reed Army Medical Center Website).

Table 2. University of Hawaii/DoD Research Subject Breakdown ($N=57$).

Role of interviewee		Organizational level		Knowledge of telemedicine		Employer	
Doctors	29	Low	7	User	28	Military	26
Others	28	Low-mid	24	Familiar	23	Gov't/private	29
		Mid-high	19	Non-user	6		
		High	7				

Demographics

We interviewed 57 people. Of those, 33 were located in Hawaii and 24 were located in the Washington, DC area. Since doctors are typically the primary users of telemedicine, a majority of the subjects was physicians. The organizational level of the subjects was also captured. Other subjects represented a full spectrum from secretaries through project personnel to high-level personnel including program directors and high-ranking officers. The mid-level ranges were for nurses and doctors of varying ranks and roles relative to telemedicine. Moreover, the University of Hawaii research team considered the input of people with limited or even no contact with telemedicine. Table 2 below gives a breakdown of the demographics of the needs assessment.

DoD NEEDS ASSESSMENT: STEP ONE – SURVEILLANCE

The Surveillance step concentrated on identifying learning needs, not developing solutions. During this stage the University of Hawaii research team performed two major activities, a presurvey and a meeting with management. The presurvey consisted of a semi-structured interview with project managers from each of the seven PRPO projects. The management meeting involved high-level PRPO managers and the University of Hawaii research team in a face-to-face meeting.

The results were used to identify the interview subjects and interview parameters for the next step, Investigation. Based on the Surveillance data, the research team created two tools; a quantitative interview instrument and a qualitative, informal-interview guide. The qualitative tool allowed subjects to express their thoughts and concerns about telemedicine in three areas: general description of their program, specific issues related to their program, and

training issues. Additionally, the tool provided the data collectors a framework within which they could accurately cull the subject's knowledge.

A quantitative instrument was created to identify potential learning objectives for a telemedicine-training program. Initially, 18 learning objectives were listed in a random order. Respondents were asked to rank the objectives with regard to importance, on a scale of 1–5. These ratings were then to be used to rank the prospective learning objectives against each other, the purpose of which was to determine those objectives that were most important to a telemedicine-training program and to see what objectives could be logically grouped into modules. An example of a question and the ranking classification is noted below.

An example of the type of question asked in the survey was:

Telemedicine Case Analysis – A presentation of how similar telemedicine programs approach the program's area of expertise. Examples from the program's clinical specialty will be explored.

1	2	3	4	5
Required	Recommended	Not sure	Not helpful	Useless

DoD NEEDS ASSESSMENT: STEP TWO – INVESTIGATION

The Investigation stage involved the actual collection of data using the tools discussed above. Also, more of the programs were observed while in action, and additional literature Internet searches were conducted.

Program Observation

The research team observed several of the programs' operations. The Pacific Oncology Outreach Program's tumor board was attended on a number of occasions. The tumor board was observed in order to identify areas where training may or may not help. This opportunity was also utilized to observe the reactions and interaction of personnel while using telemedicine.

The Pacific Island Electronic Consultation and Referral Program's website was accessed along with program personnel. Mock cases were reviewed to understand the process involved better. This was coupled with the interviews of program personnel to form recommendations for telemedicine training.

The result from the observations was a better understanding of the operational issues involved in telemedicine. By observing the projects, the research

team was able to communicate with the interviewees better. The cryptic terminology and acronyms used were defined. This allowed the interview to flow smoothly and not be stopped by questions regarding terms, etc. Overall, the program observations allowed the research team to go to the next step, Analysis, and put the data collected in a proper context.

Interviews and Surveys

The interviews occurred in two stages. The first was performed during the summer of 1999. The personnel at the various PRPO projects were interviewed. Next, during the month of December, 1999, the University of Hawaii research team met with the personnel in Washington, DC.

The interviews and surveys were conducted during the same meeting with the interview being accomplished first. At the completion of the interview, the survey was conducted. This was done purposefully because the interviewee, after 30–45 min of questioning, would give well thought-out rankings on the proposed objectives, as well as a rational proposal for additional objectives.

Within the first few interviews, the interview guide was refined to get to the most salient questions first. Because of the nature of the semi-structured interviews, a very open, free flow of information occurred. Most of the people interviewed were very excited to talk about their project and their roles within, and once they started, it was initially quite difficult to direct them to the important questions on which the interviewer wanted to concentrate.

Based on the first few interviews, 2 additional learning objectives were added to the original 18 objectives on the survey instrument. After that addition, suggestions from the interviews thereafter were encompassed within other learning objectives. In general, the tool was adequate but had one limitation. While the tool collected quantitative data, the data collected here was/were on subjective items. The learning objectives used in the survey were broadly described and open to interpretation.

DoD NEEDS ASSESSMENT: STEP THREE – ANALYSIS

Semi-Structured Interviews

Method and Results

During the Analysis stage, the semi-structured interview data and the survey data were consolidated. Well-established analysis techniques from

McArdle's 'Conducting a Needs Analysis' (McArdle, 1998), Phillips and Holton's 'Conducting Needs Assessment' (Phillips & Holton, 1995), and Soriano's 'Conducting Needs Assessments: A Multidisciplinary Approach' (Soriano, 1995) were employed. The data from the interviews were consolidated on a question-by-question basis. From the groups, opinions related to telemedicine, training, and support for the two were synthesized.

Surveys

Method
Using common statistical analysis software (Microsoft Excel) the data for each question were averaged on three different levels. First, on a program level, second, as a group of programs and third, on a learning-cluster basis, that is, each learning goal was grouped under a module heading and then averaged.

Results: Learning Cluster Formation
The primary factor in analyzing this data is to observe how each learning objective ranked in relation to the others. Based on the premise that the research team covered all potential, relevant learning objectives in a broad fashion, the research team grouped the objectives, forming what were called learning clusters. The basis behind the cluster formation was that each of the 20 learning objectives fell under one of four categories/titles: (1) Fundamentals of Telemedicine, (2) Clinical Applications, (3) Organization and Management, or (4) Technical Systems. These clusters formed the recommended structure for the web-based, interactive curriculum.

Results: Learning Objective Validation
All 20 objectives were found relevant to a telemedicine-training program. While some subjects listed 4's and 5's as answers (indicating the objective was 'not helpful' or 'useless'), none of the 20 proposed learning objectives had an average score higher than 2.5 (borderline of 'not sure' and 'recommended'). While the 2.5 average is not a concrete justification to instruct learners in all the learning objectives, the low average does indicate that the learning objectives were relevant to a telemedicine-training program and should be considered at some level.

Finally, the results of the comparison are given below:

Numerical rank out of 20	Average	Learning objective	Learning cluster
1	1.35	Telemedicine tools	Technical systems
2	1.48	Benefits to specialties	Clinical applications
3	1.54	Scheduling and location factors	Clinical applications
4	1.54	Standard operating procedures	Organization & management
5	1.63	Patient's perspective	Fundamentals of telemedicine
6	1.63	Distance education	Organization & management
7	1.65	How to conduct an examination	Clinical applications
8	1.69	International perspectives	Fundamentals of telemedicine
9	1.77	Telemedicine case analysis	Clinical applications
10	1.77	Organization and management	Organization & management
11	1.81	Failures of telemedicine	Fundamentals of telemedicine
12	1.81	Store and forward technology	Technical systems
13	1.83	Technology of telemedicine	Technical systems
14	1.85	Legal and regulatory aspects	Organization & management
15	1.85	Video conferencing technology	Technical systems
16	1.90	Future of telemedicine	Fundamentals of telemedicine
17	1.94	Web page interface technology	Technical systems

18	2.02	Telemedicine business aspects	Organization & management
19	2.25	Funding sources/ considerations	Organization & management
20	2.31	History of telemedicine	Fundamentals of telemedicine

DoD NEEDS ASSESSMENT: STEP FOUR – REPORT

The analysis was presented in a written format for delivery to the DoD leadership staff. The primary recommendation to the DoD regarding its telemedicine training curriculum centered on the aforementioned learning clusters. The University of Hawaii research team's recommendation follows.

Learning Environment

Neither observations nor interviews yielded results that were contrary to the intention of using a web-based, interactive learning environment for the content delivery. In fact, interview data indicates such to be the preferred mode. The constraints of geography, widely dispersed health care providers at stations from the Indian Ocean to North America to the European Continent, argued strongly for an Internet solution. The varied work schedules and time zone differences also indicated the need for the flexibility of a web-based, interactive learning environment.

The learning objectives were divided into types of learning which in turn drives the preferred mode of training. Three major types of learning are:

1. Effective learning which includes the fostering of attitudes, feelings, and preferences. For example, it may be desirable for participants to value a certain situation, procedure, or product. Or they may need to become more aware of their feelings and reactions to certain issues and new ideas. Effective goals are the priority when there is a lack of desire or a fear about using new knowledge or skills. This is often referred to as a 'won't do' situation.
2. Behavioral learning which includes the development of competence in the actual performance of procedures, operations, methods, and techniques. For example, participants practice skills that been have demonstrated and receive feedback on their performance. Behavioral goals are the priority when there is a lack of skill. This is often referred to as a 'can't do' situation.

3. Cognitive learning which includes the acquisition of information and concepts related to course content. Participants must not only comprehend the subject matter but also analyze it and apply it to new situations. Cognitive learning can also include the development of 'mind models' and the realization that differing cognitive scripts exist for different individuals confronted with the same initial conditions. Cognitive goals are the priority when there is a lack of knowledge. This is often referred to as a 'don't know situation'.

A study of the type of goal will lead to the type of training that is most effective. For example, behavioral goals can be thought to be most effective by instructor-led training where as cognitive goals are effective and cost efficient as web-based training. For effective goals, creating the 'cohort' effect is important. regardless of whether the training is instructor-led or web-based. To achieve effective learning, interaction amongst the cohort is central to the desired outcome. Most of the goals identified in this study were cognitive and effective, hence perfect for interactive web-based training (Phillips & Holton, 1995; Soriano, 1995; Steadham, 1980).

Training Time

The research team recommended that the total course allotment for time be broken down as listed in Table 3 below.

Structure

In addition to the creation of the learning modules, the University of Hawaii research team developed a structure and relationship scheme for the clusters. The diagram below is a graphical representation of the four learning clusters and their interrelationships. The dominant cluster is Clinical Applications with 40% of the course time allocated. The large center circle represents the clinical knowledge required by all healthcare providers. The smaller, peripheral circles represent the unique knowledge needed by each specialty.

Table 3. Learning cluster Time Allotment.

Learning cluster	Percentage of course time (%)
Clinical applications	40
Fundamentals of telemedicine	20
Organization and management	20
Technical systems	20

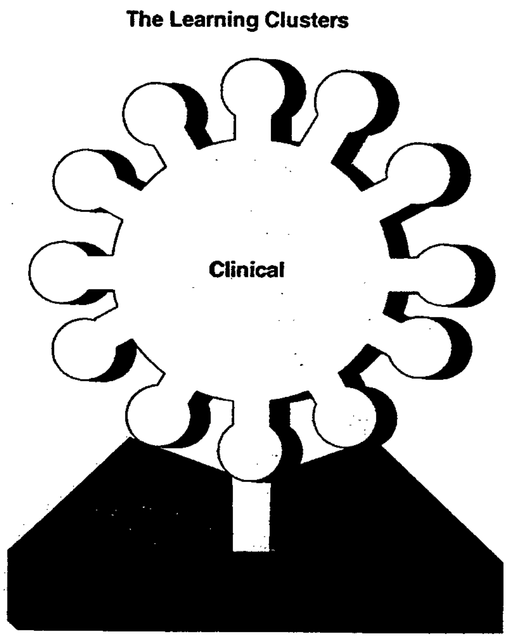

Fig. 1. Graphical Representation of Results

Emphasis on specialty focus is reflected in the second highest scoring learning ojective, 'Benefits to Specialties'. The layers represent the different knowledge needed by the different types of HCPs: physicians, nurses and technicians, which became apparent during the interviews and observations. The critical Clinical Applications cluster sits atop the Organization and Management cluster and Technical Systems cluster which in turn rests upon the Fundamentals of Telemedicine. The basic knowledge contained in the three base clusters is the same for all specialties and types of HCPs.

The Learning Clusters

Fundamentals of Telemedicine
The purpose of this cluster is to cover two primary topics, the patient's perspective and an evaluation of telemedicine in general. In addition, this cluster is to act as a marketing tool and motivate a learner to want to use the technology. The forum will be a study of past successes and failures in telemedicine and the reasons for that.

Clinical Applications

This cluster was determined to be the most important since it encompasses learning that directly relates to the provision of health care. It will also be the most challenging to design. Not only does each specialty, but also each level of HCPs (physician, nurse, and technician), have special learning needs. The University of Hawaii research team recommended that these modules be taught in two parts.

The first module has two primary topics. The first is for the learner to understand all the considerations, tangible and intangible, required by telemedicine examinations and consultations. Examples would be equipment set-up, lighting, and acoustics, as well as timing, participants' schedules, and body language. This analysis will take place via an examination of factors that will ultimately contribute to preferred clinical interaction and results. The second primary topic calls for the learner's understanding of how to conduct a telemedicine examination. The patient's perspective will again be considered as well as the roles and responsibilities of all stakeholders in the telemedicine experience.

Via problem-based telemedicine case analysis, module two will serve as an effective way to provide deeper understanding of the concepts relayed in module one. Through a thorough review of clinically related, telemedicine case studies, learners will be able to understand why their clinical specialty has a specific protocol.

Organization and Management

The objective for this module is, like the Fundamental Cluster, to act as a marketing and motivational tool. The primary topic is to explain the role of the 'telemedicine champion' and 'participant empowerment'. This cluster is based on the premise that project leaders and participants will have the ability to influence the managerial, organizational, and business systems, when necessary, for the successful utilization of their telemedicine system.

Technical Systems

The primary topic of this cluster is to convey the technologies presently being used in contemporary telemedicine. Short courses in store-and-forward, video conferencing/visiting, and web-based applications will be presented. Interactive skill-building exercises are the means toward competent execution of software/hardware applications before, during, and after a consultation.

CONCLUSION

Needs assessment played a vital role in the DoD's telemedicine training curriculum design. This needs assessment identified the learning needs of DoD Healthcare Providers and confirmed the appropriateness of a web-based interactive telemedicine-training program. It defined what should make up the curriculum, thus avoiding a possible 'false start'. This was accomplished through the 20 learning objectives and 4 learning clusters that replaced the 5 presupposed learning modules.

The needs assessment is the first phase of a cycle. It drives the development of the training program with its resultant learning objectives. Once developed, the training is conducted. The evaluation of the training should include whether the learning objectives are being used in the work place and if the organization is achieving the outcomes it desires. If the participants have taken the training into the work place, but outcomes are not being achieved, then the cycle starts again while striving to understand the learning needs of the HCPs.

REFERENCES

Blignault, I., & Kennedy, C. (1999). Training for telemedicine. *Journal of Telemedicine and Telecare, 5*, S112–S114, Abstract.

Calcagni, D.E., Clyburn, C.A., Tomkins, G., Gilbert, G.R., Cramer, T.J., Lea, R.K., Ehnes, S.G., & Zajtchuk, R. (1996). Operation joint endeavor in Bosnia: Telemedicine systems and case reports. *Telemedicine Journal, 2*, 211–221.

Davenport, T.H., & Prusak, L. (1998). *Working knowledge: How organizations manage what they know* (p. 173). Boston, MA: Harvard Business Press.

Forkner, M.E., Reardon, M.S., & Carson, G.D. (1996). Experimenting with feasibility of telemedicine in Alaska: Successes and lessons learned. *Telemed Journal, 2*, 233–240.

Goldstein, I.L. (1986). *Training in organizations: Needs assessment, development, and evaluation* (2nd ed., pp. 50–62). Monterey, CA: Brooks/Cole.

Gomez, E.R., Poropatich, R.K., Karinch, M.A., & Zajtchuk, J.T. (1996). Tertiary telemedicine support during global military humanitarian missions. *Telemedicine Journal, 2*, 201–210.

Levine, B.A., Cleary, K., & Mun, S.K. (1998). Lesson learned from the DEPRAD deployment. *Proceedings-Pacific Medical Technology Symposium – PACMEDTek* August 17–21 (pp. 423–426). Piscataway, NJ: IEEE Computer Society.

McArdle, G.E.H. (1998). Conducting needs analysis. Menlo Park, CA: Crisp Publications.

Naval Medical Research Center Website. Available at http://131.158.70.70/NMRC.htm. Accessed May 29, 2000.

Pacific Regional Program Office Website. Available at http://prpo.tamc.amedd.army.mil/. Accessed May 29, 2000.

Phillips, J.J., & Holton, III E.F. (Eds.). (1995). *Conducting needs assessment* (pp. 227–240). Alexandria, VA: American Society for Training and Development.

Soriano, F.I. (1995). *Conducting needs assessments: A multidisciplinary approach*. Thousand Oaks. CA: Sage Publications.

Steadham, S.V. (1980). Learning to select a needs assessment strategy. *Training and Development Journal, 30*, 56–61.

Telemedicine and Advanced Technology Research Center Website. Available at http://www.matmo.org/. Accessed May 29, 2000.

Tripler Army Medical Hospital Website. Available at http://www.tamc.amedd.army.mil/. Accessed May 29, 2000.

Walter Reed Army Medical Center Website. Available at http://www.wramc.amedd.army.mil/departments/tmed/. Accessed May 29, 2000.

Walters, T.J. (1996). Deployment telemedicine: The Walter Reed army medical center experience. *Military Medicine. 161*, 531–536.

INTERACTIVE LEARNING ENVIRONMENTS

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CONTENTS

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Telemedicine in otolaryngology: implications, pitfalls, and roadblocks

Lawrence P. A. Burgess, MD,*¶ Michael R. Holtel, MD,§ Stanley M. Saiki, Jr., MD,† and Joshua L. Jacobs, MD†‡

The largest obstacle to telemedicine deployment is the lack of well controlled studies validating the safety and efficacy of this type of physician-patient encounter. These studies will eventually lead to clinical acceptance and the codes for reimbursement. The second largest obstacle for telemedicine is validating the change from live, three-dimensional viewing to a two-dimensional image on a monitor. In otolaryngology, video protocols need to be standardized for flexible nasopharyngolaryngoscopy and laryngostroboscopy. Because these are already commonly viewed on a two-dimensional monitor in the live setting, reimbursement could follow for these portions of the examination in a store-and-forward format. Viewing images of the tympanic membrane will be more challenging because the resolution of binocular microscopy will be difficult to duplicate. However, if telemedicine images can safely determine the difference between a normal and abnormal tympanic membrane, patients with an abnormal image can be triaged for a live visit. Curr Opin Otolaryngol Head Neck Surg 2002, 10:194–198 © 2002 Lippincott Williams & Wilkins, Inc.

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The role of telemedicine in healthcare delivery is still evolving. A primary obstacle to widespread deployment has been the lack of validation studies of telemedicine technologies to the current standard of care. Without such research, clinicians will not accept telemedicine in their practice, and policy makers will not develop reimbursement codes for telemedicine encounters. Reimbursement is not considered one of the primary obstacles limiting telemedicine deployment.

Another significant obstacle is the inherent difficulty in converting a live three-dimensional image of a physical finding to a two-dimensional image viewed on a monitor. This is perhaps the largest technologic issue limiting deployment of clinical telemedicine systems, because the standard of care for diagnostic accuracy of clinical lesions is three-dimensional viewing through the eyes of a clinician. For live consultation, this problem can be partially overcome by changing the camera angle or zooming in and out on the lesion. For store-and-forward consultations, potential solutions could include multiple still images, stereo imaging, ability to turn or rotate the lesion on the monitor, and the use of video clips that would capture camera angle and zoom changes.

In general, current successful telemedicine projects involve diagnostic or therapeutic techniques in which either a two-dimensional image is used primarily or a three-dimensional image is not required. Once two-dimensional resolution at the receiving site is normalized to the standard of care, these programs become straightforward problems of data transfer. Currently, many mature teleradiology and telecardiology (*eg*, tele-echocardiography) projects are mostly informatics issues of data transmission of digital studies for reading at another site. This format nicely sidesteps reimbursement issues that apply for standard telemedicine consultations because it is a reading of a study rather than a clinical consultation. A strategy for specialty care would be to develop specific codes for diagnostic procedures that require video capture and review. As in radiology and echocardiography, once these codes are established, a study can be evaluated in any location after data transmission.

When three-dimensional resolution is not required, live audio-video consultation provides satisfactory communi-

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cation for consultation. Patient acceptance and clinical outcomes must equal the standard of care of a live visit. The specialties using counseling such as psychiatry and psychology have deployed many successful programs.

Reimbursement

As an emerging method of delivering care, mechanisms for reimbursement are still evolving. Medicare and Medicaid policies define government reimbursement schedules and significantly influence policies of private payers. Governmental organizations such as the Office for the Advancement of Telehealth (under the former Health Resources Services Administration) and private organizations such as the American Telemedicine Association, the Association of Telehealth Service Providers, the Center for Telemedicine Law, and others have been lobbying to stabilize government reimbursement policies.

Reimbursement for telehealth services began with the Balanced Budget Act of 1997. The most recent rules went into effect October 1, 2001, under the Medicare Benefits Improvement and Protection Act [1••]. Currently, Medicare shall pay a physician or practitioner for "telehealth services that are furnished via a telecommunications system to an eligible (Medicare part B) telehealth individual." Telehealth services include professional consultations, office or other outpatient visits, and office psychiatry services.

Payment is made to the practitioner at the "distant (receiving) site" with a facility fee of $20 paid to the "originating site." Practitioners are reimbursed at the same level as without telemedicine equipment. Standard HealthCare Common Procedure Coding System codes are used for consultations (codes 99241 through 99275), office and other outpatient visits (codes 99201 through 99215), individual psychotherapy (codes 90804 through 90809), and pharmacologic management (code 90862).

An originating site is limited to "a physician's or practitioner's office, hospital, critical access hospital, rural health clinic, or federally qualified health center." Additionally, the originating site must be located in an area that is designated a rural health professional shortage area or in a county that is not included in a metropolitan statistical area. "Fee splitting" between originating and distant sites, as had been required in the past, has been eliminated in favor of the "facility fee."

Store-and-forward consultations are not reimbursable Medicare services because the consultation must be interactive. The final rule specifies that "an interactive telecommunications systems must be used and the medical examination of the patient must be at the control of the physician or practitioner at the distant (receiving) site." An interactive telecommunications system is defined as multimedia communications equipment that includes, at a minimum, audio and video equipment permitting two-way, real-time, interactive communication between the patient and physician or practitioner at the distant site. Telephones, facsimile machines, and electronic mail systems do not satisfy the definition.

Medicaid does not recognize telemedicine as a distinct service but does allow reimbursement for telemedicine at the state's option. Private sector reimbursement likewise remains regional and nonuniform. Definition of fair reimbursement and uniform payment for telehealth services will drive use beyond capitated environments. In capitated environments, in which reimbursement is usually less of an issue for most cases, telemedicine can play a significant role in improving the efficiency of a clinical operation, even if used primarily as a triage tool.

The October 2001 Medicare rules reflect progress in stabilizing reimbursement policies under federal services. Restrictions related to site, geography, and store-and-forward modalities continue to be limiting factors. Store-and-forward consultations are easier to deploy than live visits because the consult is sent for later analysis by the reviewing provider. This asynchronous platform avoids scheduling problems between sending provider, receiving provider, and the patient. If not of diagnostic quality, it can be used as an important triage tool, determining who travels to a tertiary center for care. This platform has worked well for the authors in the Pacific, where vast distances significantly increase the cost of tertiary referrals. Improper referrals limit available funds for care of other indigent patients within capitated programs.

However, there have been few, if any, validation studies normalizing the store-and-forward platform to the standard of care; therefore, the necessary codes for reimbursement have not followed. However, progress is being made to move closer to fair reimbursement for telehealth services that can be a boon to patients. Indeed, Congress has directed the Secretary of Health and Human Services to conduct a study reviewing these issues. There is no doubt that validation studies would have a slow but important impact on reimbursement.

Credentialing and licensing

The laws governing licensure for medical practice vary by state, and few are specific for telemedicine, although the number is growing. Intrastate telemedicine consults (physician and patient reside in the same state) raise issues of privileging at the clinic or hospital where the patient is located. In general, credentialing is not required for purely collaborative interactions, and a memorandum of understanding between the provider and the institution can be written. However, if a diagnosis is rendered or treatment is undertaken, the provider must have credentials at that institution. Interstate telemedicine consults (physician and patient in different states)

raise issues of interstate licensing. Some states (*eg*, Kansas) require that a physician be licensed in that state if they are providing care to someone residing in that state. Other states (*eg*, Idaho) allow physicians to provide medical services in consultation with a locally licensed physician. Still others (*eg*, Arizona) provide for unlimited telemedical access to state residents as long as a valid license is held within the United States [2,3]. California has outlined who has ultimate responsibility for care of that telemedicine encounter, placing it on the referring physician [4]. An overview of these issues is provided by the University of Hawaii Telemedicine Curriculum Project [5••].

Telemedicine practice that crosses state lines also crosses state licensing requirements. The office of the attorney general and the individual state licensing authorities are responsible for monitoring. In this rapidly changing field, it is advisable to consult with the licensing authority of both the state in which the physician practices and the state in which the patient resides [2].

Telemedicine in correctional facilities

One excellent use of telemedicine is to provide care to correctional facilities. It deserves mention here because it exemplifies all the attributes of a successful telemedicine program, and otolaryngologists may be asked to provide services. Populations that have the potential to benefit most from telemedicine are those geographically isolated from medical care. Few would argue that prisoners in our nation's correctional facilities are extremely isolated by both vertical and horizontal geography. It is difficult to provide regular in-house care by physicians because of recruitment problems. Additionally, the cost to transport a prisoner for medical consultation is high because of required security measures, expending valuable human and budgetary resources. Costs of telemedicine visits are tied to use of the equipment, largely a fixed initial cost. The more the system is used, the lower the cost per case. In contrast, the more specialized medical services that are used in a prison population without telemedicine, the greater the cost. This finding was demonstrated in many studies, including a study of telecardiology [6] and general telemedicine [7].

Telemedicine has been used to provide medical consultations with effectiveness equal to that of face-to-face encounters without the additional expense. Telemedicine is in use in both federal [8] and state [7,9,10] prisons. A research report commissioned in 1999 by the US Department of Justice evaluated the effectiveness and cost savings of a telemedicine demonstration project in the federal prison system. The conclusions of this report were that telemedicine is cost-effective and has the potential to improve the quality of care delivered to inmates [9]. The care is acceptable to inmates. One study examined acceptance of telepsychiatric services and found no difference between the face-to-face group and the telepsychiatry group [10].

Telemedicine seems particularly well suited for providing health care in the correctional system. It minimizes security risk, has the potential to minimize costs, improves timeliness of consults [9], and is acceptable to inmates. Part of the success of this type of program is based on a strong desire and need by all parties to make it work. The prisons want to provide quality care at reduced cost, and medical consultants generally would prefer not to visit the facility.

Telemedicine in otolaryngology

Successful programs in otolaryngology depend on successful capture and transfer of images of the nasopharynx, hypopharynx, larynx, and tympanic membrane. These steps can be performed live, with a trained technician at the remote site performing the examination and the specialist directing the exam at the receiving site. Such an examination has been reported with gastrointestinal endoscopy [11]. The second option, currently not reimbursable, is to capture the examination on video clips that can be forwarded for later review with the stated history and general physical examination. Pharyngeal and laryngeal images with high-resolution capturing devices should be able to be normalized to the standard of care because, as in other endoscopic disciplines, the procedure is often accomplished in the physical setting by viewing a two-dimensional monitor, and video clips of the procedure are often obtained and used for later review.

Reimbursement codes should be developed for review of captured data such as video clips. In otolaryngology, flexible nasopharyngolaryngoscopy has a common procedural terminology code, and video capture and storage might be standardized for reimbursement and telemedicine deployment. Similarly, videolaryngostroboscopy has a common procedural terminology code. A well performed examination by a technician recorded at a remote site with reading at a central site is potentially reimbursable now because the standard for videolaryngostroboscopy is later review by the clinician on a two-dimensional monitor.

Video-otoscopic examination of the eardrum will be more difficult to validate because depth perception and resolution are more critical when examining drum landmarks. Once again, video clips of the drum at rest and with pneumatoscopy would improve the two-dimensional view of the drum on a monitor. Current imaging systems also use a telescope, resulting in enhanced optics and resolution. Critics contend that the standard for any difficult ear exam is binocular microscopy, which may never be equaled with a still image or video format.

However, unlike teleradiology and telecardiology, diagnostic accuracy for video-otoscopy is not always the required outcome. It is equally valuable when used as a triage tool, with abnormal or questionable evaluations requiring a different level of evaluation or physical referral. The authors routinely triage like this in their practice. If the tympanic membrane examination is not entirely normal using hand-held otoscopy, the authors use binocular microscopy as the next standard of care. For telemedicine consultations, if the diagnosis of normal cannot be made with a telemedicine image, the patient is triaged to a physical visit.

In the authors' preliminary data, normal drums and abnormal drums were readily distinguished on still images, a critical element in the triage pathway. Additionally, a still image was equal to the diagnostic accuracy of hand-held otoscopy, important if standardized to the routine otolaryngic examination only as opposed to being validated against the standard of a binocular microscopic examination. With validation of video-otoscopy for normal eardrum examinations against hand-held otoscopy, the potential exists for store-and-forward approaches to certain hearing loss diagnoses.

Safety of such programs can be determined through well-structured research protocols. Once standard of care is validated, these programs can be deployed in health maintenance organizations or capitated environments in which reimbursement is not an issue. Further data would form the groundwork for policy changes surrounding reimbursement for store-and-forward platforms.

Live audio-video teleconference could be used for speech therapy. The preliminary results of the authors' in-house study validate the use of teleconferencing for speech therapy compared with conventionally treated patients [12]. With validation, the next step is to provide speech therapy services to remote patients. Audio-video teleconference has also been used for preoperative surgical consultation in another specialty [13]. The use of audio-video teleconference for live intraoperative surgical consultation in endoscopic sinus surgery has opened the door for national and international collaboration. The authors' results for an in-house study indicate that it may be performed safely, and there is an additional positive benefit for resident training and education [12,14].

With data captured through more sophisticated digital devices used in telemedicine, it is possible that these tools will assist the physician in making diagnoses [15••]. The authors participated in a pilot project with hyperspectral imaging in which the bacterium in otitis media in an experimental model was diagnosed by the spectral scan of the eardrum. This method would lead to the optimal initial antibiotic therapy, reducing persistent disease and recurrences.

The following reasons for failure of telemedicine programs have been reviewed: unproven clinical efficacy, lack of reimbursement, legal and credentialing issues, and technologic barriers. Other implementation barriers are lack of a clinical champion, a poor business case analysis, and organizational barriers. In the Army Medical Department, organizational factors were considered the most significant issue limiting implementation in a survey of 62 high-level health care providers [5••]. Cost-effectiveness of telemedicine in otolaryngology [16] has been reviewed in one program. Organizational changes [17•] and the new relationships of telemedical work and cooperation [18•] have been studied recently.

Conclusions

For telemedicine to be successful in otolaryngology, rigorous protocols need to confirm the clinical efficacy and safety in relation to the current standard of care. This step will eventually lead to reimbursement by policy makers and acceptance by referring and consulting providers. Standardizing video recordings of tympanic membranes, flexible nasopharyngolaryngoscopy, and laryngostroboscopy will be instrumental in this process.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:
- • Of special interest
- •• Of outstanding interest

1 •• Medicare rules and regulations for telemedicine reimbursement. Federal Register 66(212):rules and regulations 55281–55285. November 1, 2001. Available at: http://www.americantelemed.org/news/FederalRegisterpgs37–41.pdf. Accessed December 21, 2001.
The October 2001 Medicare rules regarding telemedicine reimbursement.

2 Arent, Fox, Kintner, et al.: Case study 2-5: Interstate licensing. July 17, 1997. Available at: http://www.arentfox.com/quickguide/businesslines/telemed/e-health_telemed/e- healthnewsalerts/telemed_coc/telemed_coc.html. Accessed November 26, 2001.

3 Telemedicine information exchange: legislative, legal and policy issues in telemedicine. March 5, 2002. Available at: http://tie.telemed.org/legal/regulation. Accessed April 1, 2002.

4 Hutchinson JRB: Telemedicine in otolaryngology. Otolaryngol Clin North Am 1998, 31:319–329.

5 •• Friedman R, Pepper S: University of Hawaii telemedicine curriculum, 2001. Available at: http://www.uhtelemed.hawaii.edu. Accessed December 24, 2001.
A good online resource for both general and specific telemedicine issues.

6 McCue MJ, Hampton CL, Malloy W, et al.: Financial analysis of telecardiology used in a correctional setting. Telemed J E Health 2000, 6:385–391.

7 Zollo S, Kienzle M, Loeffelholz P, et al.: Telemedicine to Iowa's correctional facilities: initial clinical experience and assessment of program costs. Telemed J 1999, 5:291–301.

8 Harris G: Telemedicine in federal prisons. Telemed Today 1999, 7:29–32.

9 McDonald D, Hassol A, Carlson K, et al.: Telemedicine can reduce correctional health care costs: an evaluation of a prison telemedicine network, March 1999. Available at: http://www.ncjrs.org/telemedicine/toc.html. Accessed November 20, 2001.

10 Brodey BB, Claypoole KH, Motto J, et al.: Satisfaction of forensic psychiatric patients with remote telepsychiatric evaluation. Psychiatr Serv 2000, 51:1305–1307.

11 Kim CY, Etemad B, Glenn TF, et al.: Remote clinical assessment of gastrointestinal endoscopy (tele-endoscopy): an initial experience. Proceedings American Medical Informatics Association; Annual Symposium. Philadelphia: Hanley and Belfus; 2000:423–427.

12 Burgess LP, Holtel MR, Syms MJ, et al.: Overview of telemedicine applications for otolaryngology. Laryngoscope 1999, 109:1433–1437.

13 Aarnio P, Jaatinen P, Hakkari K, et al.: A new method for surgical consultations with videoconference. Ann Chir Gynaecol 2000, 89:336–340.

14 Burgess LP, Syms MJ, Holtel MR, et al.: Telemedicine: teleproctored endoscopic sinus surgery. Laryngoscope, 2002, 112:216–219.

15 Syms MJ, Syms CA: The regular practice of telemedicine. Arch Otolaryngol •• Head Neck Surg 2001, 127:333–335.
An overview article on telemedicine issues in otolaryngology.

16 Bergmo TS: An economic analysis of teleconsultation in otorhinolaryngology. J Telemed Telecare 1997, 3:194–199.

17 Aas IHM: A qualitative study of the organizational consequences of telemedi- • cine. Telemed Telecare 2001, 7:18–26.
A study on organizational issues surrounding telemedicine implementation.

18 Aas IHM: Telemedical work and cooperation. Telemed Telecare 2001, • 7:212–218.
A study reviewing provider attitudes on changes in consultation methods with telemedicine.

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Telemedicine in otolaryngology

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Telemedicine is becoming increasingly difficult to separate from the rapidly expanding field of e-health, or Internet health. Telemedicine encompasses a broad spectrum of technologies to include telementored surgery, continuing medical education, remote diagnosis, tumor boards, and robotics. In its purist clinical application, telemedicine is a medical consultation and remote diagnosis or treatment of a patient. One of the simplest forms is the telephone consult, progressing through the more involved store-and-forward of images for asynchronous viewing by a consultant, to the more bandwidth demanding "live" forms of video teleconferencing. Different levels of technical complexity are required for various telemedicine consults, and the simplest forms should be considered first. In the past, the form of the consult often depended on what technology was available and, regrettably, whether it could be reimbursed.

Telemedicine began in the 1950s and 1960s, but only one project, in Newfoundland, persisted beyond those years. Bashshur [1] divides the history of telemedicine into three eras: (1) the telecommunication era, in which telemedicine depended on broadcast and television technologies, which proved to be costly, cumbersome, and unreliable systems; (2) the digital era, which started in the late 1980s with the digitalization of telecommunications and advancements in computers but had limited and expensive bandwidth; and (3) the Internet era, which is less expensive, is more readily available and accessible by the general population, and allows extensive networks. With the current testing of Internet 2 (I2) or Next Generation Internet

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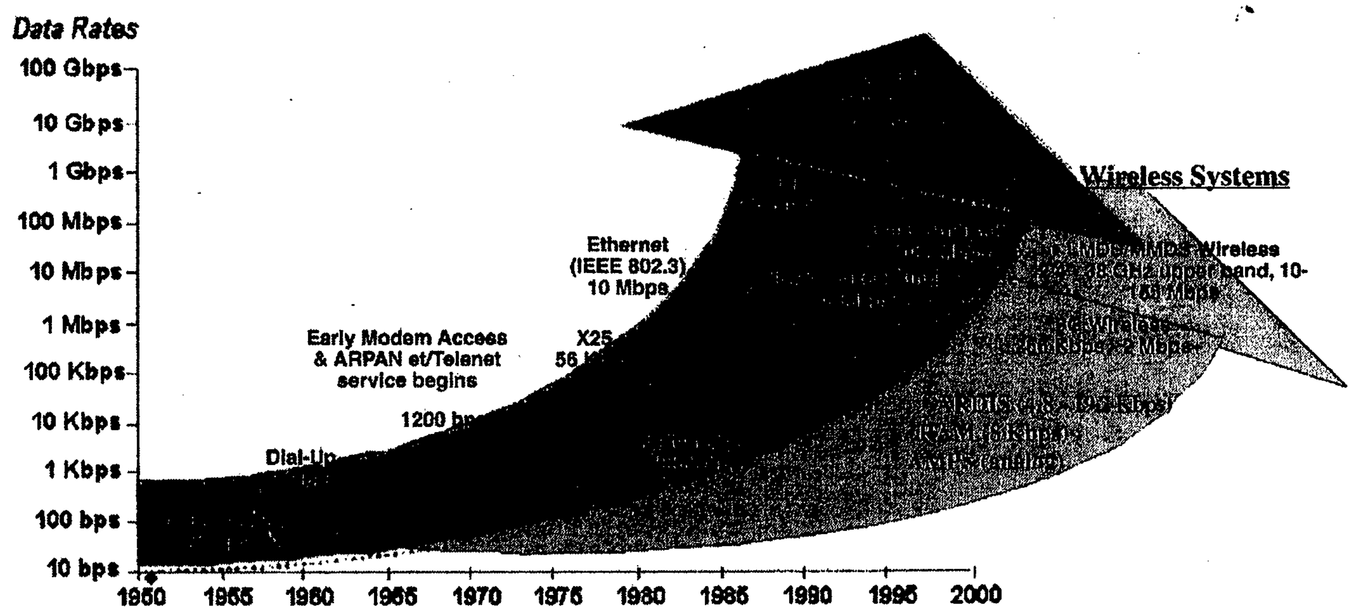

LEGEND:

- Frequency Band Trends (39-50 MHz, 150 MHz, 400 MHz, 800 MHz, 700 MHz, 2.5 GHz, 5 GHz, 28GHz, 38 GHz)
- Local/Multichannel Multipoint Distribution System (LMDS/MMDS)
- Wireless; Analog/Digital Cable Technology (unlicensed - 2.4–2.5 GHz bands; licensed -24–38 GHz bands with data rates in the 1.5 to 155 Mbps range)
- RAM - Radio Analog Mobile Service
- ARDIS - Advanced Radio Data Information Service
- AMPS - Analog Mobile Paging System

Fig. 1. Progressive expansion of bandwidth. (*From* Ackerman M, Craft R, Ferrante F, Kratz M, Mandil S, Sapci H. Telemedicine technology. Telemedicine Journal and E-Health 2002;8:71–78; with permission.)

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(NGI) comes the promise of increased speed (100- to 1000-fold increase in bandwidth) and increased possibilities (Fig. 1).

Most telemedicine programs in the telecommunications and digital eras closed when their external funding stopped; however, the Internet era is demonstrating sustainability. Telemedicine programs in a number of states are seeing rapid growth. In its seventh year, the Arizona telemedicine program cited an increase of 25% to 30% without a planned Internet related growth, expanding from 65 sites in 2002 to 100 sites in 2003, with 60 subspecialties [2]. Since 1996, the University of California at Davis Telehealth program has encompassed 15 community hospitals in an area covering more than two thirds of the state. The University of Texas Medical Branch in Galveston, Texas, performs 1900 live video telemedicine conferences per month and has performed 53,000 visits to date [3]. Nesbitt [4] noted that telemedicine now exists in all 50 states; a national program exists in Malaysia. He attributed the growth of telemedicine to decreased equipment and transmission costs, increased bandwidth, improved reimbursement, continued maldistribution of health care specialists, and a widening knowledge gap between primary caregivers and specialists due to the explosion of medical knowledge. He also credits improved outcomes in specific areas by more experienced providers, and a more Internet-savvy patient population who increasingly want the expertise brought to them as increasing the acceptance of telemedicine.

Maldistribution of health care specialists is at the core of telemedicine; it is what has driven telemedicine since it was first applied in the 1950s and 1960s for underserved rural areas, as well as socially and geographically isolated populations. The American Academy of Otolaryngology's Workforce 2000 study demonstrated that the field of otolaryngology is no exception to the trend of specialists concentrated in urban areas (Fig. 2). Despite this disparity, otolaryngology is still relatively new to the field of telemedicine. Issues of bandwidth, equipment costs, and the inability to be reimbursed have kept the specialty from advancing.

Success in telemedicine

The first successful fields in telemedicine were those that most closely approximated daily clinical practice of the specialty: radiology and pathology. Krupinski [5] first advocated for patience with the progress of telemedicine in other specialties, noting that the fields of radiology and pathology have been working on telemedicine for 35 years. She outlined a number of reasons for telemedicine's success in radiology, including:

1. parallels with the current practice of interpreting images without the patient present (ie, the task has not changed);
2. the same technology as current practice, including digital acquisition as well as store-and-forward and real-time exams;

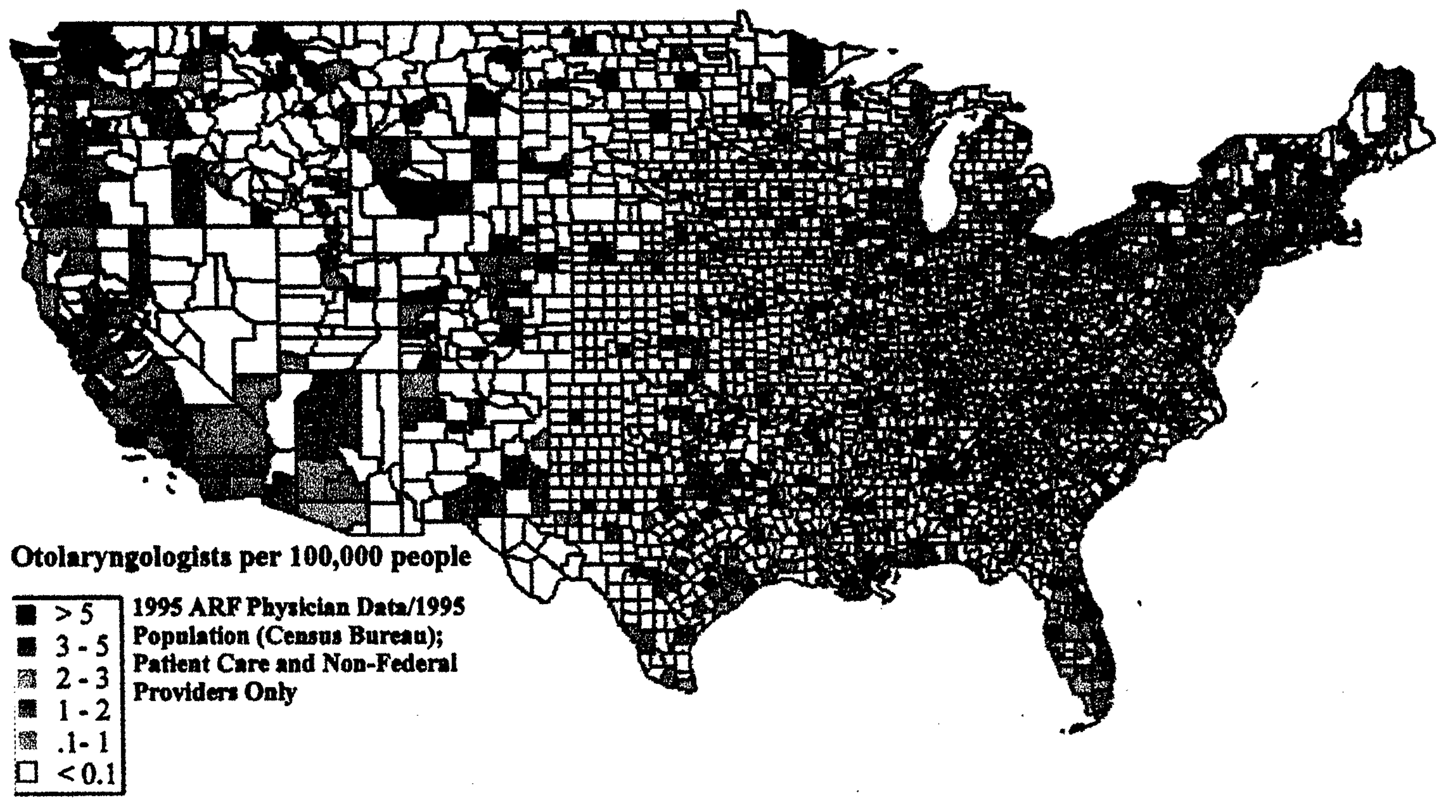

Fig. 2. Distribution of otolaryngologists throughout the United States. (*From* The Otolaryngology Workforce Study, AAO-HNS Bulletin, March 2002; with permission.)

3. digital imaging and communications in medicine (DICOM) standards, which include hardware and software integration, data transmission, data security, image display, and compression;
4. data on infrastructure, acquisition, displays, and ergonomics;
5. efficacy (ie, it works with results being billed and paid for);
6. surpassing of diagnostic impact to demonstrate increased report quality in one study;
7. avoiding transportation of patients; and
8. integration into the radiology culture, with oral boards being given using digital images.

Although these reasons for success cannot all be applied directly, certainly approximating current practice where possible, establishment of standards, data, efficacy, and incorporation into our culture are important for otolaryngology telemedicine programs.

Success in telemedicine is no longer restricted to medical specialties that do not require the patient to be present; psychiatry using video teleconferencing is considered a mature telemedicine application. Krupinski et al [6] pointed to cardiology, dermatology, and ophthalmology as maturing specialties. Telemedicine intensive care programs using video teleconferencing have been started at a number of institutions. The critical ingredient for success is demand; this is probably the single most important lesson learned from past and present programs. Telemedicine is most successful where the need is greatest: in areas of geographic or social isolation, such as prisons, Native American reservations, the military, and rural settings [7,8]. Another example is the University of Texas Medical Branch in Galveston, Texas, which established a telemedicine clinic in the corporate offices of a large insurance company headquartered in Galveston. This fulfills the need of reducing employee time away from work [3]. The intensive care programs fulfill a need that results from a shortage of intensivists. Home care programs fulfill the need of an aging population that is experiencing increased difficulties in making trips to their physicians. In addition to the criteria of fulfilling a need, successful programs follow the same guidelines as most any successful business (Box 1).

General concepts in telemedicine

Telemedicine is typically divided into real time or video teleconferencing (VTC) and store-and-forward. In real time or VTC, the consultant and requesting physician see the patient at the same time. In store-and-forward, the patient is seen asynchronously. Store-and-forward has been embraced mostly by those specialties that rely in some part on pattern and image recognition being predominantly visual, such as pathology, dermatology, and radiology. The VTC format has progressed more in specialties requiring significant physician–patient dialogue or interaction, such as psychiatry and intensive care.

Box 1. Factors associated with successful models

Clear mission and rationale for telemedicine
Support from the top of the organization
Accountable leadership and governance of program
Solid business plan with adequate financial support, with adequate start-up time allowed
Well-defined service or target population
Clear need for services offered
Well thought out operational model
Committed service providers capable of providing the needed services
Referral guidelines and protocols that assure timeliness of service and appropriate cases for telemedicine
Continuous quality improvement that includes evaluation of satisfaction and outcomes
Technology that is appropriate for the application
Reliable technology and telecommunication
Adequate procedures and personnel for technical problems
Comprehensive training program for hub as well as spoke site personnel
In the end it must deliver value to those involved
Document and report the benefits

Data from Nesbitt TS. Models of telemedicine. Presented at the American Telemedicine Association Annual Meeting. Los Angeles, June 5, 2002.

Store-and-forward allows consultants the advantage of reviewing the case at their convenience (eg, between cases in the operating room). Store-and-forward requires the referring physician to input the patient's history, physical exam, laboratory studies, or radiology studies, thereby having the potential to make the consultant more time-efficient because examinations and studies do not have to be repeated. Store-and-forward can ease scheduling problems for programs that cover a large number of time zones. The Pacific Island Health Care Project at the authors' (MRH) institution uses store-and-forward consultation to cover five time zones, which includes the International Date Line. Although bandwidth is less likely to be an issue in the future, store-and-forward uses less bandwidth (Table 1). It is likely that use of store-and-forward consults will increase once reimbursement issues are resolved.

Currently, VTC is the more common format. The equipment and bandwidth is more expensive, but it is more readily reimbursed. VTC provides immediate feedback for the referring physician and allows for more direct

Table 1
Bandwidth speeds

Lines	Speed	Video
POTS	28.8–56 kbps	3–8 fps (compressed)
DSO (DS 2600)	64 kbps	8 fps (compressed)
Single ISDN	128 kbps	16–20 fps (compressed)
Triple ISDN	384 kbps	28 fps (compressed)
T1 or DS1	1.55 mbps	30 fps (compressed)
ATM or DS3	45 mbps	30 fps (uncompressed)

Abbreviations: fps, frames per second; ISDN, Integrated Services Digital Network allows voice, video and data transmission; kbps, kilobits per second or 1,000 bits per second; mbps, Megabits per second or one million bits per second; POTS, plain old telephone service; T1, larger digital signal carrier defined by carrying capacity of 1.55 mbps.

Data from Reid J. A telemedicine primer: understanding the issues. Billings (MT): Artcraft Printers; 1996.

interaction between the patient and specialist. Interoperative or telementored surgery, critical intensive care patients, and consultations that may require some real-time instruction (eg, the use of nasopharyngoscopy) demand VTC's interactivity and immediate feedback.

Telemedicine in otolaryngology

Otolaryngology is still an emerging specialty in telemedicine, but it has embraced both store-and-forward and VTC. Most of the initial projects were demonstration projects, but otolaryngology is successfully using telemedicine in a variety of clinical practices. The combination of a small population spread over great distances and a high incidence of otitis media and its complications among Native Alaskans has created a need for otolaryngology telemedicine consultation in Alaska. The Alaska Federal Health Care Access Network (AFCHAN) project connects 235 remote sites (many accessible only by plane) using predominantly satellite links. Use of store-and-forward consultation has decreased demand for limited bandwidth from remote sites and has allowed these sites to transmit over 2000 ear images (Stewart Ferguson, Ph.D., personal communication, 2002).

The Southern California/Tricare Region 9 Military program uses VTC consultation with a web-based appointment scheduling system to cover seven military bases throughout Southern California. Although bandwidth is readily available in this successful model, for referring military institutions such as Twenty-Nine Palms, CA, the nearest town may still be a 1-hour drive. Otolaryngology is the most commonly requested consult, with 3000 otolaryngology consults completed; 600 surgical cases have had their preoperative evaluations done remotely (Darrell Hunsaker, M.D., personal communication, 2002).

In other examples, the need for otolaryngology is a small part of larger telemedicine programs. The University of California at Davis Telehealth

program, which was begun in 1996, used VTC and reported that otolaryngology totaled 7% of its first 1000 consults [9]. Adopting a web-based store-and-forward consult system in 1997, the Pacific Island Health Care Project at the authors' institution provides health care to Micronesia and American Samoa. Approximately 10% of the first 1500 consults were for otolaryngology. Otolaryngology plays similar roles in other statewide, national and international programs. Blakeslee et al [10] reported use in a private practice model, but success in private practice is not well documented.

The number of telemedicine programs in otolaryngology is not known, but the Telemedicine Information Exchange Website (www.tie.telemed.org, a nonprofit organization for research sponsored by the National Library of Medicine) lists 16 programs. Of the 16 programs listed, two used store-and-forward forms of consultation and 14 used VTC. The reason for a significantly larger proportion of programs using VTC may be due to difficulties in reimbursement with the store-and-forward format rather than preference for the live format; however, for "closed" models (eg, health maintenance organizations), reimbursement concerns would not apply. It is likely that a large number of otolaryngologists use the simplest form of store-and-forward telemedicine—e-mail—but the exact numbers are not known.

Just as certain medical specialties (such as psychiatry, which requires significant patient interaction) favor the VTC format, those areas of otolaryngology that require significant patient interaction are currently best addressed in this format. Rehabilitation services for vestibular dysfunction [11], dysphagia [12], cochlear implants [13], voice therapy [14], and telepresence/telementoring [15] of live surgical cases currently demand the interactive capabilities of VTC. The Internet tumor board at the author's (MRH) institution provides a hybrid of store-and-forward and live interaction. The cases to be presented are loaded on a Website that can be viewed before and during the tumor board. A telephone conference call is used for the live interaction component, with the Web images viewed on the participants' computers. Other institutions have chosen VTC for their tumor boards with remote locations. The authors currently use VTC and the telephone for remote speech therapy, but plan to progress to a hybrid model. Using a Web-based program and digital input from external microphones, voice therapy exercises could be monitored through a laptop computer at the patient's home or referring clinic. When the program detects the patient performing outside preset voice goals, a report would be generated and sent to the speech therapist, who would review it and decide whether a VTC session is warranted.

Clinical efficacy studies

Concept studies have demonstrated the potential usefulness of telemedicine in otolaryngology [14]; determining clinical efficacy is the next step. One of the first research questions that must be answered is whether or not a

remote telemedicine examination (either VTC or store-and-forward) is as accurate as an in-person clinical examination. Kappa coefficients (K) measure agreement. Sclafani et al [16] suggested that for agreement of clinical diagnoses "a K > 0.5 is excellent and a K > 0.4 is acceptable" and provided the following assessment: "A K value approaching 1 may only indicate that the question was too broadly posed to be significant. Large variations in K can be expected when either the number of answer pairs is small or the number of expected agreements is high (caused by either extremely common or extremely rare events)." A common statistical textbook definition is given in Table 2.

Clinical efficacy in nasopharyngoscopy and laryngology

In 1994, Pedersen et al [17] compared 24 in-person examinations with real-time VTC examinations of those patients. Only six of the patients underwent nasopharyngoscopy; no statistical analysis was performed because there was 100% agreement in diagnosis.

In 1998, Furukawa et al [18] recorded still images from 29 previously videotaped nasopharyngoscopic examinations of the larynx. One set of images was printed out and examined locally, while another set was stored as a series of JPEG images and transmitted electronically to a distant site for diagnosis. Again, no statistical analysis was performed because unanimous agreement was reached in diagnosis between the local and distant examiners.

In 1999, Sclafani et al [16] examined specific physical findings, such as mass and erythema as well as anatomic location, through the nasopharyngoscopic exam. They performed nasopharyngoscopy on 45 patients comparing in-person clinical examinations with remote examinations with a 384-kbp video teleconferencing system and delayed remote examination (recorded on the same system). K values varied by anatomic site and physical finding. For the true vocal cords, K values were 0.992 for VTC exam and 0.441 for delayed remote exam agreement with in-person exam. For hypopharyngeal masses, K values were 0.337 for VTC and 0.429 for remote examination agreement with in-person exam. These K values compared to agreement of 0.784 for true vocal cords and 0.444 for hypopharyngeal mass when a chief resident and board certified otolaryngologist both examined the same patients in person.

Table 2
Kappa values

0–0.20	Slight agreement
0.21–0.40	Fair agreement
0.41–0.60	Moderate agreement
0.61–0.80	Substantial agreement
0.81–1.00	Almost perfect agreement

Marathe et al [19] observed 19 patients with laryngeal masses as part of a blinded nonrandomized study of 59 patients with laryngeal complaints. Video clip images were stored as AVI files and reviewed in a delayed store-and-forward format. K values for agreement of laryngeal mass between in-person and delayed store-and-forward examination ranged from 0.66 to 0.79 with all K significant ($P < 0.001$). More importantly, there was disagreement on only 1 of the 19 laryngeal mass cases, a patient with vocal cord nodules. No laryngeal tumors were missed.

Clinical efficacy in video otoscopy

Clinical efficacy data is less available in video otoscopy. In unpublished data on 60 patients, we examined the agreement of store-and-forward diagnoses of normal ears, otitis media, and perforations to in-person examinations. K values for agreement of diagnosis by board-certified otolaryngologists ranged from 0.400 to 0.573. In unpublished data from Alaska, using store-and-forward telemedicine for tympanostomy tube follow-up, a substantial agreement between in-person and still image examination was demonstrated with K values ranging from 0.65 to 0.76 (Chris Patricowski, M.D., personal communication, 2002).

Clinical efficacy in rehabilitative otolaryngology

The authors are currently analyzing their data to demonstrate efficacy in voice therapy through a VTC format. Vestibular [11], dysphagia [12], and cochlear implant rehabilitation [13], have undergone proof of concept studies, but there are no clinical efficacy studies to date.

Reimbursement

Typically, private insurance companies follow the government's lead with regard to payment. Past Medicare rules had limited payment for VTC to rural areas with a 25%–75% fee-splitting formula between the referring and consulting physicians, respectively, and did not allow payment for store-and-forward telemedicine. The Medicare, Medicaid, and Separate Child Healthcare Insurance Program, Benefits Improvement and Protection Act of 2000 (BIPA) Public Law 106-554 eliminates fee splitting, expanding Medicare payment to equal the amount the provider would receive without telemedicine. A facility fee of $20 is paid to the originating facility, which may include a physician or practitioner's office, a critical access hospital, a rural health clinic, a federally qualified health center, or a hospital. BIPA allows for store-and-forward reimbursement, but only for pilot studies in Hawaii and Alaska (www.aamc.org or the Centers for Medicare and Medicaid

Services, formerly HCFA www.hcfa.gov). Many states are slowly adopting Medicare requirements for Medicaid reimbursement.

Despite Medicare's reluctance to embrace store-and-forward telemedicine, private insurance carriers are reimbursing physicians. Although they have not yet billed for otolaryngology services, the Arizona telemedicine group regularly receives reimbursement for the store-and-forward format using standard Current Procedural Terminology (CPT) coding from private carriers. They encountered only one insurance provider in the state who denied reimbursement for store-and-forward telemedicine consults. Their payers do not require a "GT" modifier (identifying them as telemedicine), but they recommend at a minimum identifying the services within the text of the consult as telemedicine [20]. Partners™ out of Massachusetts has billed for otolaryngology cases in a store-and-forward format as part of a comprehensive internet consultative service that has seen over 5000 consultations in all specialties; however, this service requires a single advance cash payment of $350 for consultation and does not use CPT coding [21].

Although their familiarity with diagnoses from images have driven the fields of both radiology and pathology to improve telemedicine practice, Dena Puskin, the Director of the Office for the Advancement of Telehealth in US Health Resources and Service Administration points out that it is the standards, data, and publishing efficacy that has led to their acceptance and reimbursement. She cites this as a model for other medical specialties to achieve success in acceptance and reimbursement [22].

Licensure and credentialing

Although medical licensure requirements vary among states, providers are required to obtain a medical license in the state in which the patient resides (Fig. 3). Nursing is moving toward a federal license. Currently, 18 states have adopted the interstate compact that allows nurses to practice across state borders.

In its 2001 revisions, the Joint Commission on Accreditation of Hospital Organizations (JCAHO) established standards for credentialing and privileging in Telemedicine (Box 2).

Legal issues

The Health Information Portability and Accountability Act of 1996 (HIPAA), Public Law 104-191, mandates that electronic health information be protected. Protections under HIPAA are scheduled for placement by October 13, 2002, with compliance mandated after April 14, 2003. Haigh [23] asserted that VTC over Integrated Services Digital Network and T1-3 lines will be considered "voice phone systems" and will not require encryption. VTC over the Internet will require secure virtual private network (VPN) technology. VPNs provide an encrypted connection or "tunnel" through the

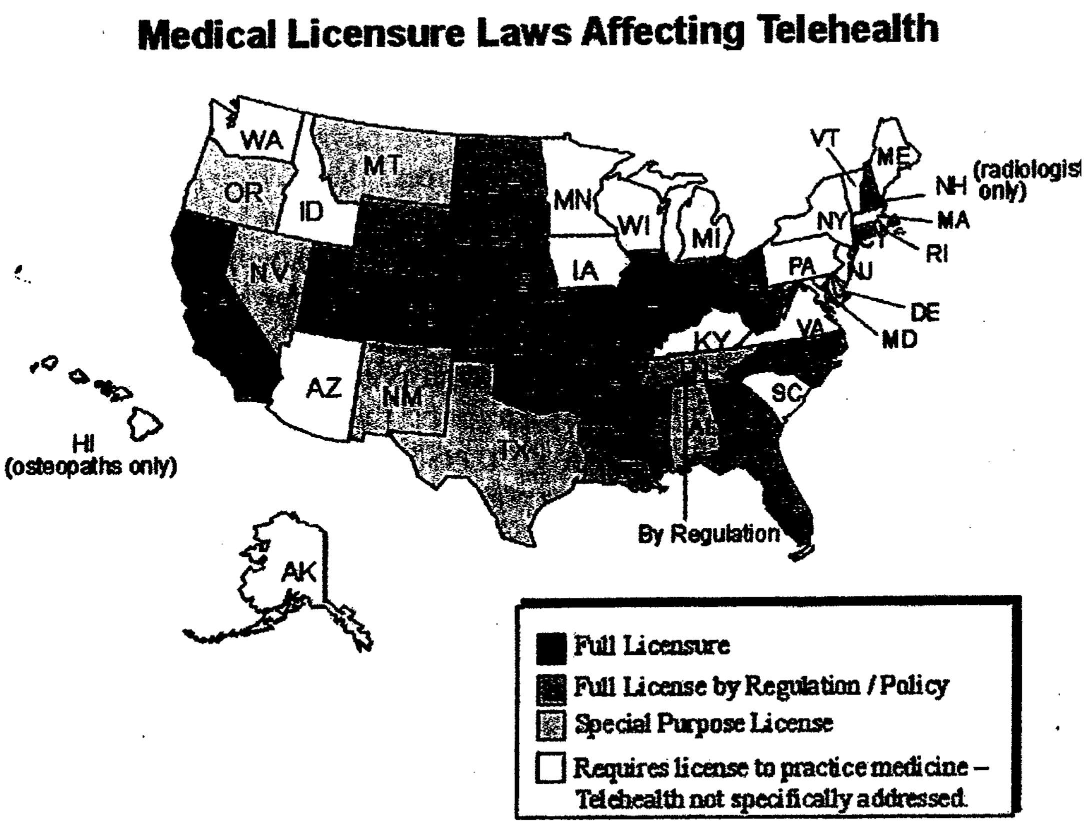

Fig. 3. Map of telemedicine licensure laws affecting telehealth. (*From* http://www.arentfox.com/quickGuide/businessLines/telemed/e-health_telemed/e-health-state/map-licensure/map-licensure.html.)

Internet that permits a user's distributed sites to communicate securely. The encrypted tunnel provides a secure path for network applications and requires no changes to the application (www.csm.ornl.gov). Store-and-forward, including its simplest form (e-mail), will require similar protection [24].

HIPAA affects the privacy of health information in all formats (eg, paper, electronic, fax, voice) and therefore has likely already been addressed in many otolaryngology practices. Its goals include providing consumer control of health information, making covered entities responsible and accountable for protecting an individual's health information, and placing limitations on the uses and disclosures of this information. HIPAA does not preempt more stringent state or federal health information privacy requirements. Specifics on HIPAA rules, including consent, access, security, responsibility, and oversight, can be obtained from the US Department of Health and Human Services, Office of Civil Rights Website (www.hhs.gov/ocr/hipaa/) and the American Academy of Otolaryngology Bulletin Website (www.entlink.net/press/bulletin/view-the-bulletin.cfm).

Equipment

Most otolaryngologists are familiar with charge coupled device (CCD) cameras attached to a nasopharyngoscope as input devices for telemedi-

Box 2. JCAHO credentialing and privileging in telemedicine

MS 5.16: "Practitioners who diagnose or treat patients via telemedicine link are subject to the credentialing and privileging processes of the organization that receives the telemedicine service."

MS 5.16.1: "The medical staff recommends the clinical services to be provided by telemedicine."

Intent of MS 5.16 through 5.16.1 states: "An organization may use credentialing information for another Joint Commission accredited facility, so long as the decision to delineate privileges is made at the facility that is receiving the telemedicine service."

Data from The Joint Commission on Accreditation of Hospital Organizations. Available at: www.jcaho.org/accredited+organizations/hospitals/standards/revisions/2001/medical+staff.htm. Accessed June 24, 2002.

cine exams. The video otoscope used for input of ear exams is a rigid Hopkins rod telescope similarly connected to a CCD camera (Fig. 4). These input devices are connected to VTC and store-and-forward systems (Figs. 5, 6). Because of the inability of printed text to keep up with the rapid changes in specific telemedicine equipment, the Telemedicine Information Exchange (tie.telemed.org) and American Telemedicine Association (www.americantelemed.org) Websites are better sources of current information.

What does not become obsolete in equipment selection is the importance of human factor considerations. Because of the competing demands on their time, surgeons in particular have little patience for new systems that do not work easily and properly. A Ph.D. in human factors was one of the first members of our telemedicine team. Before commencing telemedicine studies, we examined ease of use for software and hardware. The Alaska Telemedicine project relies on health aids as referring providers rather than primary care physicians. Accordingly, their software uses touch screens with relatively few large buttons to simplify sending consults. The Arizona Telemedicine program employs a Ph.D. in human factors to ensure similar concerns are met within their program. Once the equipment is selected, training is an equally important step. Again, the goal is seamless use of telemedicine upon the first consult. Proper equipment and training are essential to achieve this.

Cost

Equipment costs and bandwidth costs have dropped significantly; VTC systems that once cost $60,000 now cost $6000. Yet telemedicine has been shown to be cost effective only when patient travel time and expense is taken into account [7]. Prisoner transport costs with an armed guard can

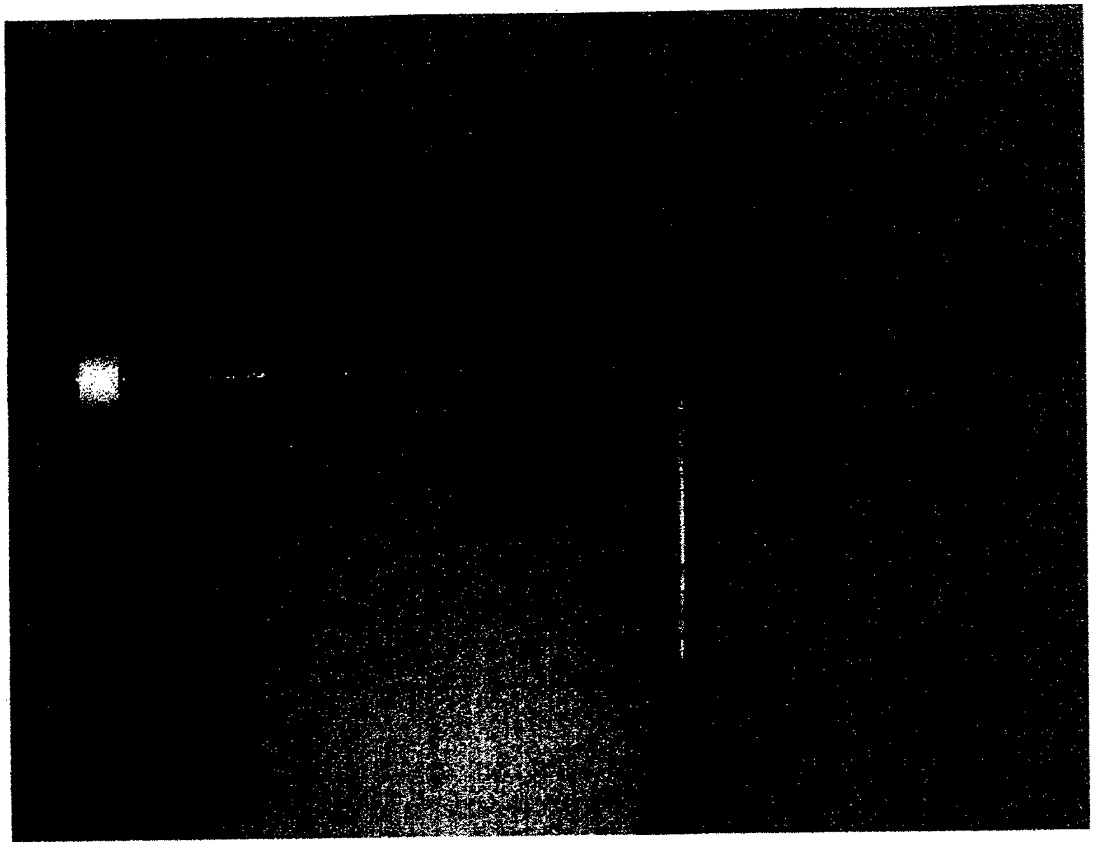

Fig. 4. Typical camera and otoscopy handpiece.

significantly add to the cost of a visit for a patient. A cost analysis study in Arizona found that the break-even point was if travel costs were considered for rural patients who traveled more than 70 miles. Few cost analysis studies for otolaryngology are available. Bergmo [25] found teleconsultation cheaper in Norway where the consulting hospital was 400 km away, with more than 56 and less than 325 patients per year. When more than 325 patients were seen, it was less expensive for the otolaryngologist to visit the referring clinic. In a closed (HMO) model, the Southern California/Tricare Region 9 demonstrated over $400,000 saved if the patients had been transported to the Naval Hospital in San Diego, but fixed costs are not calculated (Darrell Hunsaker, personal communication, 2002). Cost analyses have generally been performed in large telemedicine organizations in which otolaryngology has played a role [7]. Fortunately, the fixed costs (eg, equipment prices) continue to drop, thereby continually improving the business model.

Krupinski [5] noted that telemedicine may also be a loss leader (a referral source that will make you money when the patient comes in for the surgery even though the initial telemedicine consult does not make money). E-mail with or without attachments is the simplest form of store-and-forward telemedicine and is currently used by many otolaryngologists as a loss leader.

Other benefits to private practices include raising profiles with referring MDs and an increase in unusual referrals due to a greater geographic reach

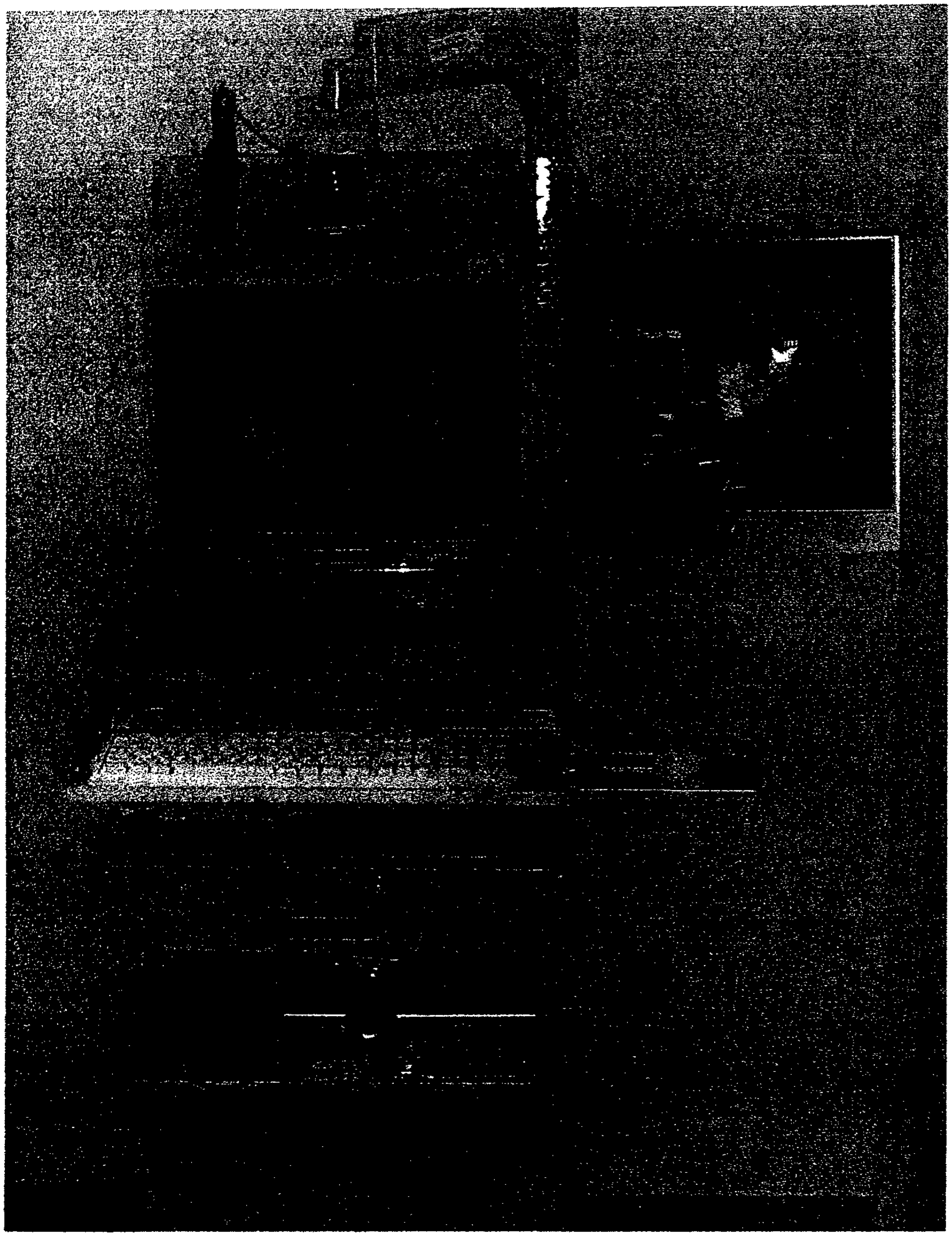

Fig. 5. Tanberg VTC system currently in use at Honolulu VA Clinic, Hawaii.

[21]. For example, an otolaryngologist with a strong interest in cleft lip and palate repair might have an increase in referrals.

Teleproctored/telementored surgery

Telemedicine consultation in the operating room between surgeon and specialist (or subspecialist) allows a more experienced surgeon to mentor

Fig. 6. Image capture with store and forward system currently in use at Tripler Army Medical Center.

or proctor a less experienced surgeon. The authors' study of 45 endoscopic sinus surgery patients demonstrated that cases took an average of 3.87 minutes longer per side when teleproctored, but could be accomplished with no difference in complications or safety in selected patients [15]. Numerous teleproctored proof-of-concept studies have been completed. We currently have a VTC connection between operating rooms in Guam and Hawaii to assist with difficult cases or in cases where specific specialists are not available in Guam.

Telepresence using robotics with haptic (touch) or force feedback has been accomplished in proof of concept. Telepresence refers to the use of robotic equipment to assist the surgeon at the same location. In its simplest form, a robotic arm might serve as an assistant to the primary surgeon in performing laparascopic or endoscopic surgery. The surgeon controls the arm through a foot pedal or voice commands, while the surgeon's own hands are controlling other instruments. Some might argue that this is not true telepresence, because the surgeon is not removed from the patient. More complex robotic devices assist surgeons performing highly complex technical procedures, such as heart surgery. Surgeons operate at a console in the surgical suite, with the robot placed over the patient. The robot improves the technical abilities of the surgeon by gearing precise

instrument movements to larger hand movements, requiring less fine motor technical ability from the surgeon than would normally be required.

Telesurgery, a form of telepresence, employs robotic devices controlled from another location. Unlike in-room forms of telepresence, this increases the technological sophistication of the procedure, because the connections through switching or conversion devices will increase the delay that the surgeon will experience. Signals travel at the speed of light (186,000 miles per second). Therefore, a distance of 5000 miles (eg, Honolulu to Washington, DC) will result in a delay of 0.02689 seconds because of distance alone. Conversion of analog to digital signals and digital back to analog at the receiving end will increase this delay, as will delays through switches and routers. This is not an issue for telementoring, because total delays are less than a second, but such delays for telesurgery can lead to unacceptable visual and haptic feedback for the surgeon.

Summary

More research is needed in otolaryngology telemedicine, but it would be a mistake to stop at only determining if telemedicine is as good as an in-person exam. The digital image recorded in a telemedicine encounter can be manipulated to increase diagnostic information not currently available. Radiologists currently take a chest radiograph in which a chest mass or the tip of an nasogastric tube is difficult to visualize, and by inverting the gray scale or viewing other digital manipulations of that image, the mass or tube tip becomes obvious. Examples in otolaryngology might include images of the larynx manipulated to better demonstrate the inflamed tissue of reflux, or images of the tympanic membrane manipulated to better demonstrate early retraction.

Despite dramatic and likely continued decreases, equipment cost is still an issue. Current research points to good consumer acceptance, and certainly with each new generation the technology is more readily accepted. As Nesbitt [4] points out, it is certainly not difficult to look to the future and see ubiquitous broadband with video as common as telephone, or even extreme broadband enabling robotics and virtual reality TV with three-dimensional touch. Robotics and genomics will eventually play a greater role in telemedicine and our lives in general. Applications for remote diagnosis in biologic warfare defense and homeland security are currently raising interest in telemedicine. Telemedicine will be combined with new technological advances such as virtual "fly-through" computerized axial tomography examinations. Instead of performing an exploratory tympanotomy, surgeons will use computer programs to "fly through" and examine all aspects of a patient's middle or even inner ear. Spectral imaging of the eardrum, larynx, or oropharynx will immediately identify bacteria without cultures, or gram stain, and potential malignancy without biopsy. By measuring fluorescence emitted from an oropharynx illuminated with a

specific visible or nonvisible light spectrum, spectral imaging will be able to provide instant identification of bacteria or evidence of malignant changes. The underlying principles of a successful business model must continue to be applied, with the most critical ingredient for telemedicine's success being the filling of specific health care needs. As long as the need is there, telemedicine in otolaryngology will advance.

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References

[1] Bashshur RL. Telemedicine and health care. Telemedicine Journal and E-Health 2002;8: 5–12.
[2] Weinstein RS. Building successful telemedicine programs. Presented at the American Telemedicine Association Annual Meeting. Los Angeles, June 5, 2002.
[3] Raimer BG. Using telemedicine to increase productivity in the workplace. Presented at the American Telemedicine Association Annual Meeting. Los Angeles, June 3, 2002.
[4] Nesbitt TS. Building successful telemedicine programs. Presented at American Telemedicine Association Annual Meeting. Los Angeles, June 5, 2002.
[5] Krupinski E. Building successful telemedicine programs. Presented at the American Telemedicine Association Annual Meeting. Los Angeles, June 5, 2002.
[6] Krupinski E, Nypaver M, Poropatich R, Ellis D, Safwat R, Sapci H. Clinical applications in telemedicine/telehealth. Telemedicine Journal and E-Health 2002;8:13–34.
[7] Hailey D, Roine R, Ohinmaa A. Systematic review of evidence for the benefits of telemedicine. J Telemed Telecare 2002;8(Suppl 1):1–30.
[8] Burgess L, Holtel MR, Saiki SM, Jacobs JL. Telemedicine in otolaryngology: implications, pitfalls, and roadblocks. Current Opinion in Otolaryngology–Head and Neck Surgery 2002;10:194–8.
[9] Nesbitt TS, Hilty DM, Kuenneth CA, Sefkin A. Development of a telemedicine program. West J Med 2000;173:169–74.
[10] Blakeslee DB, Grist WJ, Stachura ME, Blakeslee BS. Practice of otolaryngology via telemedicine. Laryngoscope 1998;108:1–7.
[11] Virre E, Warner D, Balch D, et al. Remote medical consultation for vestibular disorders: technological solutions and case report. Telemed J 1997;3:53–7.
[12] Pearlman AL, Wiithawaskul W. Real-time remote telefluoroscopic assessment of patients with dysphagia. Dysphagia 2002;17:162–7.
[13] Goldenberg D, Wenig BL. Telemedicine in otolaryngology. American Journal of Otolaryngology 2002;23:35–43.
[14] Burgess L, Holtel MR, Syms MJ, Birkmire-Peters DP, Peters LJ, Mashima PA. Overview of telemedicine applications for otolaryngology. Laryngoscope 1999;109:1433–7.
[15] Burgess L, Syms MJ, Holtel MR, Birkmire-Peters DP, Johnson RE, Ramsey MJ. Telemedicine: teleproctored endoscopic sinus surgery. Laryngoscope 2002;112:216–9.
[16] Sclafani AP, Heneghan C, Ginsburg J, Sabini P, Stern J, Dolitsky JN. Teleconsultation in otolaryngology: live versus store-and-forward consultations. Otolaryngology–Head and Neck Surgery 1999;120:62–72.

[17] Pederson S, Hartvisken G, Haga D. Teleconsultation of patients with otorhinolaryngologic conditions: a telendoscopic pilot study. Arch Otolaryngol Head Neck Surg 1994;120: 133–6.
[18] Furukawa M, Furukawa MK, Mizojiri G, Matsuda H. Telemedicine in laryngology. Telemed J 1998;4:329–33.
[19] Marathe US, Holtel MR, Burgess LP, Syms MJ, Birkmire-Peters DP. Comparison of live and stored digital image laryngeal examinations. Presented at the American Academy of Otolaryngology Annual Meeting. San Diego, September 25, 2001.
[20] Barker GP. Telemedicine as a business. Presented at the American Telemedicine Association Annual Meeting. Los Angeles, June 5, 2002.
[21] Kvedar JC. Teleconsultation: the medical director's prospective. Presented at the American Telemedicine Association Annual Meeting. Los Angeles, June 5, 2002.
[22] Puskin DS. Telemedicine: follow the money. Online Journal of Issues in Nursing 2001; 6:Manuscript 1. Available at: www.nursingworld.org/ojin/topic/tpc16_1.htm. (Accessed June 24, 2002.)
[23] Haigh PJ. Telemedicine under HIPAA. Telemedicine Journal and E-Health 2002;8:A18.1.
[24] Loane M, Wootton R. A review of guidelines and standards for telemedicine. J Telemed Telecare 2002;8:63–71.
[25] Bergmo T. An economic analysis of teleconsultation in otorhinolaryngology. J Telemed Telecare 1997;3:194–9.

Designing Web-based, Telemedicine Training for Military Healthcare Providers

(Running title: Designing Web-based, Telemedicine Training)

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Designing Web-based, Telemedicine Training for Military Healthcare Providers

Abstract:

Background: The purpose of the study was to ascertain those learning objectives that will initiate increased utilization of telemedicine by military healthcare providers. Telemedicine is increasingly moving to the center of the healthcare industry's service offerings. As this migration occurs, health professionals will require training for proper and effective change management. The United States Department of Defense (DoD) is embracing the use of telemedicine and wishes to use web-based training as a tool for effective change management to increase utilization. This article summarizes the findings of an educational needs assessment of military healthcare providers for the creation of the DoD web-based telemedicine training curriculum.

Methods: Forty-eight (48) healthcare professionals were interviewed and surveyed in order to capture their opinions on what learning objectives a telemedicine training curriculum should include.

Results: Twenty (20) learning objectives were found to be needed in a telemedicine training program. Additionally, these 20 learning objectives were grouped into four learning clusters that formed the structure for the training program. In order of importance, the learning clusters were clinical, technical, organizational, and introduction to telemedicine.

Findings: From these clusters, the five web-based modules were created with two addressing clinical learning needs and one for each of the other learning objective clusters.

Key Words:

Educational Needs Assessment, Learning Needs, Learning Objectives, Telemedicine, Military Healthcare

Introduction:

The Institute of Medicine, National Academy of Sciences, defines telemedicine as "the use of electronic and telecommunications technologies to provide and support health care when distance separates the participants."[1] While many definitions of telemedicine have been put forward, most define the concept in terms of moving medical information over distance. Telemedicine is a way of providing quality, effective and efficient diagnoses, and clinical interventions by utilizing the real-time, or near real-time, two-way transfer of medical information between places of lesser and greater medical capability and expertise.[2,3]

Many think that telemedicine has existed for twenty years. With the emphasis on "high-tech" for the last decade, it is an understandable misconception. In fact, telemedicine has been around far longer. In 1906, Einthoven used that era's "high-technology" to transmit electrocardiograms.[4] While early applications were single-purpose in nature and accentuated technical, rather than consultative aspects of telemedicine, the present applications are beginning to offer improved access to care for rural residents, at costs which are declining with technological innovation.[5]

The organizational change that occurs within a medical care system when new technology is introduced is often difficult to anticipate. Depending upon the intrusiveness of the technology, the changes in the organization may range from minor to profound. Telemedicine is a technology of the most intrusive sort. It utterly changes

aspects of the process and structure of diagnosis and patient-doctor communication in the medical setting. It is expected that the introduction of telemedicine will have significant impact upon the medical organization at both the micro and macro level of organizational functioning, which may lead the members of the organization to reject the technology.

Successful implementation requires that individuals think differently about their job tasks – the cognitive conceptualizations of their jobs. This learning process involves dismantling old procedures and attitudes, moving to a new pattern and then cementing this new process into the procedures of the individual and groups. The decision to utilize telemedicine in the most rational manner may be diverted by selective perception, mismatch of problem solving stages, human error, and limited memory. An effective training program can aid in this cognitive shift.

There exists substantial research on the costs and benefits of telemedicine[6,7,8,9,10,11]. Here the fundamental research question is how do the costs of the application relate to the benefits of the telemedicine application compared to the alternative delivery methods? The most commonly used unit of analysis is often cost/benefit ratio. The main costs of telemedicine are fixed rather than variable, and as such, is difficult to reduce. Therefore, this ratio is most effectively reduced by substantially increasing numbers of consults (a benefit). This reduction is the primary intended outcome of the training that was researched and designed in this study. During the last ten years, the US military has been increasingly designing, prototyping, establishing, and deploying telemedicine. In pursuing its desire to capture the potential benefits of telemedicine, the DoD has entered into a cooperative agreement with the

University of Hawaii to create a web-based training curriculum for the DoD Health Care Providers. There are examples of organizations using computer technology for health professional education, and the DoD would like to utilize computer technology similarly.[12] The end product of the agreement is a five-module training course that is accessible on-line and not to exceed ten-hours in length. This will give DoD health professionals access to the training they need, in its dispersed environment.

Methodology:

This needs assessment involved four steps: Surveillance, Investigation, Analysis, and Reporting.[13] Surveillance involved the identification of learning needs through observation of the telemedicine process, interviews with users and non-users of telemedicine, discussions with senior managers, and an Internet search.[14] The Investigation stage included collecting data via a review of existing documentation, additional interviews, and surveys. Analysis was the confirmation of the need for such a training program, the selection of the methodology for developing the training program, and substantiation of the participants' need to learn. The need is expressed as learning objectives and those objectives are grouped into learning clusters. The clusters are formed primarily based upon the expertise of the four teams tasked to create the modules. Physicians comprised team one, technologists formed team two, management specialists made up team three, and team four was formed from telemedicine project managers. Finally, Reporting involved a prepared report for delivery to the DoD management office with the research team's suggested approach.

Prior to this learning needs assessment, a comprehensive analysis of the need for telemedicine in the Pacific region for the Army was completed by the Akamai Group at

Tripler Army Medical Center[15][16]. Primarily, the vast distances in the Pacific region result in high costs for medical evacuations. The study also found that over 50% of such evacuations were avoidable. Hence, the study concluded that telemedicine, if significantly utilized, could contribute to improved access and reduced costs of the DoD medical services. The DoD then engaged, through a cooperative agreement, the University of Hawaii to develop training modules designed to enhance telemedicine utilization by the military health care provider.

The research was expected to achieve the following:

- Determine if telemedicine training is needed.
- Determine what DoD healthcare providers' learning needs are.
- Determine if distance learning methods, such as web-based learning modules, would be appropriate for telemedicine training.
- Determine the content of distance education modules that will best teach healthcare providers how to use telemedicine.
- Validate or revise the DoD predicted learning modules
- Identify modules that have the highest priority.
- Identify learning objectives appropriate for the learning modules with highest priority.

Instrument:

During the surveillance and investigation steps, face to face interviews were conducted with the research subjects. The research subjects were chosen because of their position within the military healthcare system and their location in Honolulu and Washington DC, the interview sites. These interviews consisted of open-ended questions that allowed the respondents the opportunity to express their opinions on the

experience or inexperience in the past, present, and/or future as it related to telemedicine. (For a list of the questions used, refer to Appendix 1.) Surveys were conducted at the conclusion of the interviews. The survey's purpose was to get an indication of what the research subject thought appropriate learning objectives would be for a telemedicine training program.[17] (For a list of the learning objectives, see Appendix 2.) In total, there were 57 respondents involved in the needs assessment. However, because of time constraints 9 respondents were unable to complete the survey. This article will focus on the results of the post-interview surveys. The characteristics of the research subjects can be found in table 1.

The survey began with a list of eighteen objectives that the research team believed relevant to a telemedicine training program (Appendix 2, objectives 1-18). The objectives were broad and all encompassing for multi-disciplinary respondents. Each was verbally descriptive of the general concepts that may be taught in the prospective training. Respondents were asked to rank the objectives using a 5-point rating scale. The end of the survey included a section where the respondents could write-in what they believed should be included as an objective.

This needs assessment asked for the opinions of both users and non-users of telemedicine. This was due to the fact that the training curriculum was being designed for both experienced and novice users of telemedicine. Furthermore, respondents ranged in their rank within the DoD's hierarchy from Non Commission Officer to Colonel.

Data Collection:

The survey was first administered in July of 1999 and last administered in December of 1999. After the first set of surveys, due to responses to write-in question,

the two additional learning objectives were included to make a total of 20 objectives (Appendix 2, #19 & #20). This number of objectives (20 total) remained throughout the rest of the needs assessment. No other topics were suggested. Apparently, the respondents felt that the list was comprehensive. The needs assessment included respondents from two areas of the country. Thirty-three (33) respondents were from DoD Tripler Army Medical Center and St. Francis Medical Center in the State of Hawaii and 15 were from Walter Reed Medical Center, Bethesda Navy Medical Center, and Telemedicine and Advanced Technology Research Center the Washington DC area. In total, there were 57 persons interviewed. However, because of time constraints, nine respondents were not able to complete the survey. The survey was given after the interview.

Sample:

Table 1 below describes some of the characteristics of the subjects answering the survey.

Table 1

Sample Characteristics
N = 48
8 distinct telemedicine initiatives or background experiences
46 respondents were involved in DoD healthcare delivery
21 respondents were military personnel
24 respondents were medical doctors
32 respondents are male
42 respondents were telemedicine users or had regular contact

Findings:

The surveys were coded with a 5-point rating system. Words relevant to the need of a learning objective were used to stimulate accurate representation of the respondent's opinion, see appendix 2. Analysis on this data included the calculation of each learning objective's mean score. Table 2 below captures the average rank from

the 48 respondents for each objective. The lower the score, the higher the importance to training programs. For more description of what the Learning Objectives comprises, see Appendix 2.

Table 2

Learning Objective	Rank
Telemedicine Tools	1.35
Telemedicine's Benefits to Clinical Specialties	1.48
Scheduling and Location Factors	1.54
Standard Operating Procedures	1.54
Patient's Perspective	1.63
Distance Education	1.63
How to Conduct an Examination	1.65
International Perspectives	1.69
Telemedicine Case Analysis	1.77
Organization and Management	1.77
Failures of Telemedicine	1.81
Store and Forward Technology	1.81
Technology of Telemedicine	1.83
Legal and Regulatory Aspects	1.85
Video Conferencing Technology	1.85
Future of Telemedicine	1.90
Web Page Interface Technology	1.94
Telemedicine Business Aspects	2.02
Technology Applications of Telemedicine	2.25
History of Telemedicine	2.31

The results were interpreted that learning objectives close to a mean score of 1.0 should certainly be included in any program that was created. Mean scores of approximately 2.0 were interpreted as courses that should be strongly considered in the training curriculum. Scores greater than 2.0 were interpreted as potentially useful as supporting material for training. While some respondents ranked a few learning objectives as 4 = Not Helpful and 5 = Useless, none of the twenty proposed learning objectives had an average score higher than 2.31.

Conclusions:

The fact that the mean scores were less than 2.31 is not concrete justification to instruct learners in all of the learning objectives. The research team primarily interprets the results as a strong indicator that the twenty learning objectives that were found are relevant to a telemedicine-training program and should be considered at some level. Since the learning objectives were thus deemed relevant, a second interpretation of the results found how each learning objective ranked in relation to the others establishing a hierarchy of importance to a prospective training program.

Based on the premise that the research team covered all potential, relevant learning objectives in a broad fashion, we grouped them to form what we called learning clusters. The premise behind the cluster formation was that each of the twenty learning objectives fell under one of four categories/titles:

- Clinical Applications of Telemedicine
- Technology of Telemedicine
- Organization and Management of Telemedicine
- Fundamentals of Telemedicine

Once these learning clusters were formed, the highest ranked learning objectives within the cluster were noted. Then, using the total course ten-hour time limit, modules 2, 3, and 4 listed above were each allotted two-hours. Module 1 was allotted four-hours and broken into two two-hour modules. This was because Clinical Applications was ranked as the most important and relevant to the use of a telemedicine training program. Listed below in Table 3 are the learning clusters. The recommended learning objectives are noted along with their rank out of a pool of twenty.

Learning Cluster Question Groups and Rankings

Table 3

Cluster	Learning Objectives	Average
Clinical	Scheduling and Location Factors Benefits to Clinical Specialties How to Conduct an Examination Case Analysis	1.61
Technology	Telemedicine Tools Store & Forward Technology Video Conferencing Technology Web Page Technology Technology of Telemedicine	1.76
Organizational	Standard Operating Procedures Organization and Management Business Aspects Funding Considerations Distance Education Legal and Regulatory Aspects	1.84
Introductory	Patient's Perspective International Perspectives History of Telemedicine Failures of Telemedicine Future of Telemedicine	1.87

Recommendations:

Practice:

A learning needs analysis is typically performed if an organization wants to:

1. overcome performance problems,
2. introduce new systems, tasks, or technology,
3. and benefit from a perceived opportunity.

This needs analysis patterns the second situation vis-a-vis the introduction of telemedicine into the military healthcare system. If properly introduced and utilized, telemedicine has the potential to improve healthcare on three key dimensions – quality, cost, and access. Unfortunately, the short history of telemedicine abounds with stories of promising technology that failed to achieve its potential. With this understanding, the

DoD has initiated the development of a set of distance learning modules that have a didactic purpose: to teach healthcare providers how to use telemedicine and hence increase its utilization. This needs analysis, therefore, sought to identify learning needs, which may be appropriately addressed by distance learning modules.

To this end, similar to Rogers in her article on education needs for oncology nurses[18], our team has identified a broad core curriculum covered by five learning modules. The purpose of these learning modules is not to create experts in the use of telemedicine, rather the training is intended at this level to acquaint a new user with the systems generally employed by their organization.

Limitations:

The DoD is currently conducting numerous telemedicine initiatives throughout the world[19]. Our sample was limited to forty-eight people, some of which were not military personnel. The personnel that were contacted were from prominent telemedicine initiatives located in Hawaii and Washington, DC. The problem seen here is that a large number of knowledgeable telemedicine users with military medical experience were not interviewed. Thus the conclusions drawn here are limited because of a small sample size, which is possibly biased towards certain specialties, modalities, and locations. Due to confidentially, we get not capture which surveys were completed by physicians and which were completed by other health care professionals, hence we do not know if the perceptions of learning needs are different.

Future Research:

As previously mentioned, the learning objectives that the needs assessment identified are broad in scope, yet cover most obstacles facing the military health care system as it implements telemedicine. Future needs assessment research should proceed on two-prongs. The first effort should encompass the learning needs of a non-military healthcare organization. For example, the military operates under different fiscal and legal control systems and therefore are likely to have some needs that do not match the non-military sectors such as private and non-profit medical organizations.

The second effort should encompass research that specifically targets the needs of various specialties. For example, while radiology and psychology can both take advantage of telemedicine, it is likely that their needs are not the same. By virtue of the fact that their primary modalities are different (graphic images for radiology and real-time video for psychology), there are certain to be different needs for the two specialties.

Learning Needs Assessment may inform the designers of training programs.

For telemedicine to achieve satisfactory cost benefit ratios, the number of telemedicine consults must be significantly increased.

Training is one primary method of increasing utilization of telemedicine.

Military health care providers at Tripler Army Medical Center and in the Washington DC area ranked twenty key learning objectives for training that is intended to increase telemedicine utilization.

Appendix 1

Face-to-Face Interview Guide

Begin with broad questions that allow the interviewees to discuss what they felt was important:

1. To help me better understand your organization, please tell me a little about your duties at ___________.
2. How are your responsibilities affected by telemedicine?
3. From your point of view, is telemedicine very effective? What is its potential?
4. Regardless how effective they are, all organizations have some things that get in the way of their success. What things get in the way of telemedicine's effectiveness?

Questions used to have the interviewees elaborate on specific areas they may have not discussed in answering the first four questions.

5. Describe how coordination occurs between you and others involved in telemedicine.
6. What about communication surrounding the telemedicine initiatives? What is like? How does it happen? What works well? What gets in the way of effective communication?
7. Focusing on human resources (people) issues and programs, tell me what is it like to work here in telemedicine.
8. Are there human resource issues or programs that need more attention?
9. Focusing on the leadership as a team, rather than individually, what do you think the leadership team needs to do more of? Less of?
10. Are there restructuring changes that you would recommend?
11. What budget reallocations seem logical?
12. What are two or three recommendations that might result in improving any the areas we have discussed?

Training Specific Questions:

13. Based on your experience with telemedicine, in the beginning, do you feel that you had a clear understanding of what telemedicine was and its potential within your project/program?
14. How did you progress to your present level of telemedicine skills and knowledge? Self-taught, informal training, formal training?
15. What format did the training take place. Book, classroom, on-line, and hands-on.
16. Based on the training described in #14, which methods do you feel is best when bringing new HCP's into your project/program?
17. What areas of training would you have liked more emphasis on? Less? Are there any areas that were of no value to you?
18. What would be more effective, an intensive training course in a couple of days or a module like training course over a longer period?

19. What would the time be for your choice in #17? 2 x 8 hour days or 1 hour a day over 2 weeks. Other?
20. Do you feel on-going training would be helpful for those above, below, or at the same level as you? Are there specific groups?
21. What amount of time should be spent?

Appendix 2

Face-to-Face Learning Objective Survey

SCENARIO: You are the manager of the ________ program's telemedicine program. You are assigned new healthcare providers (HCPs) that will be part of your program. The HCPs include doctors and nurses that have medical experience but no telemedicine experience. You decide to train them on various issues relative to telemedicine so that they can quickly understand how telemedicine affects medicine and your program. The topics below are training courses designed to acquaint the HCP with telemedicine.

INSTRUCTIONS: Consider the topics and how being trained about them may or may not have helped you in the beginning stages of your telemedicine program. Think of how they may or may not help the new HCPs. Rank them from 1 to 5 based on the value system below. Note: Some topics may not be helpful or have any use to your program.

1 - Required   2 - Recommended   3 - Not sure   4 - Not Helpful   5 - Useless

1. Patient's Perspective – Discussion on what the patient thinks of telemedicine. Examples of the patient's concerns with privacy, comfort, and safety will be presented and discussed.

2. Standard Operating Procedures – A discussion on the DoD's requirements, as well as the program's requirements for paperwork, consult scheduling, and other protocol.

3. Organization and Management – A discussion detailing the program's mission and its position in the military hierarchy. The program's power structure will be discussed, letting the HCPs know where they fit in.

4. Scheduling and Location Factors – A discussion about the special concerns with time and location when setting up consults. Factors relating to equipment set-up, lighting, acoustics, and others will be explored.

5. Telemedicine Business Aspects – A discussion on the program's cost factors and how to run a cost-effective program.

6. Funding Sources/Considerations – A discussion on reimbursement for this type of medical care.

7. Distance Education – A discussion on how education in the healthcare industry is being affected by telemedicine.

8. International Perspectives – A discussion on how telemedicine is used and affects those overseas and/or otherwise isolated.

9. Legal and Regulatory Aspects – A discussion on the ramifications of intra-state, inter-state, and international telemedicine.

10. History of Telemedicine - A discussion on how telemedicine has evolved.

11. Failures of Telemedicine – A discussion on where telemedicine has not worked and why.

12. Telemedicine Tools – A discussion on what tools and equipment are needed for the program specialty and how to use them.

13. Store and Forward Technology – A special course in the use of MPEG, JPEG, and similar software/hardware applications.

14. Video Conferencing Technology – A special course in the use of video conferencing software and hardware with special attention to clarity of pictures and sound.

15. Future of Telemedicine – A discussion on the various telemedicine applications that may soon come about.

16. Telemedicine's Benefits to Clinical Specialties (Radiology, Dermatology, Endocrinology, Cardiology, etc.) – A discussion on how telemedicine specifically effects the program and clinical specialty.

17. Web page Interface Technology - A course in the design and use of web-page data gathering options and their capabilities and limitations.

18. How to Conduct an Examination – A course on the methods used in the program's interaction with patient's and colleagues.

19. Technology of Telemedicine – A discussion on the present technological applications of telemedicine.

20. Telemedicine Case Analysis – A presentation of how similar telemedicine programs approach the program's area of expertise. Examples from the program's clinical specialty will be explored.

Are there any course titles or descriptions that you did not see but think would be appropriate for HCPs new to telemedicine? Please list below.

[1] Field, M.J. (Editor, IOM), *Telemedicine: A Guide to Assessing Telecommunications in Healthcare*, Washington D.C., National Academy Press, 1996.
[2] Bangert D, Choi, Warren, Doktor, Garshenk, Logan, Enhancing medical decision making through telemedicine. International Journal of Healthcare Technology and Management 2000; 2(1,2,3 &4): 255-270
[3] Crump, Pfeil. A telemedicine primer: An introduction to the technology and an overview of the literature. Archives of Family Medicine 1995; 4(9): 796-803
[4] Vidmar DA. The history of teledermatology in the DoD. Advances in Military Dermatology 1999; 17(1): 113-124
[5] Zajtchuk R, Gilbert G. Telemedicine: A new Dimension in the practice of medicine. Disease-A-Month 1999; 45(6): 197-264
[6] Beach, M, Goodall, I, Miller, P. Evaluating telemedicine of r minor injuries units. Journal of Telemedicine and Telecare, 6 Suppl 1:S90-2, 2000
[7] Whitten P, Kingsley C, Grigsby J. Results of a meta analysis of cost-benefit research: is this a question worth asking. Journal of Telemedicine and Telecare. 6 Suppl 1:S4-6, 2000
[8] Palet T. A cost-benefit analysis of the effect of shipboard telemedicine in a selected oceanic region. Journal of Telemedicine and Telecare. 6 Suppl 1:S65-67, 2000
[9] Lathan CE, Sebrechts MM, Newman, DJ, and Doarn, CR. Heuristic evaluation of a web-based interface for internet telemedicine. Telemedicine Journal. 5(2):177-185, 1999 Summer
[10] Navein J, Arose D, Pietermich A. A business model for telemedicine. Journal of Telemedicine and Telecare. 5 Suppl 1:S76-78, 1999
[11] Preston J. Texas Telemedicine Project: a viability study. Telemedicine Journal. 1(2):125-132, 1995 Summer
[12] Change BL, Trelease R. Education of health professionals using a proposed telehealth system. Proceedings AMIA Symposium 1999;(1-2):496-500
[13] McArdle GEH. Conducting Needs Assessment. Menlo Park, CA: Crisp Publications, 1998
[14] Philips JJ, Holton III, EF. Conducting Needs Assessment. Alexandria, VA: American Society for Training & Development, 1995
[15] Cornwell, D. A Cost Benefit Of Telemedicine: An Assessment Of Aero-medical Evacuation Patients Throughout The Pacific Basin, August 1995 (report prepared for the Department of Defense)
[16] Logan, J. Healthcare Needs Assessment in the Pacific, 1998 (report prepared for the Department of Defense)
[17] Soriano, FI. Conduction Needs Assessment: A Multidisciplinary Approach. Thousand Oaks, CA: SAGE Publications, 1995
[18] Rogers MP. Continuing Education Needs of the Office Oncology Nurse. The Journal of Continuing Education in the Health Professions 1999; 19: 34-44
[19] www.tatrc.org

Appendix K

Presentations

Using Telemedicine and the Chronic Disease Model to Improve Quality of Diabetes Care in Hana Community Health Centers

Joe Humphry, MD
Hana Community Health Center

May 9, 2001

Starbulletin.com
Tuesday, October 2, 2001

Dengue outbreak spreads beyond East Maui

More than 100 cases of the mosquito-borne fever are suspected from Hana to Haiku

Hana Facts

- The trip takes approximately 2.5 hours along a single lane road with 617 turns and 56 one-lane bridges
- Hana is the third poorest community in the state
- . The majority of Hana's 2000+ residents, 62%, are Native Hawaiian/Part Hawaiian.

Hana Facts

- Poverty rates in Hana are 14% at the 100% level and 47% at the 200% level
- Native Hawaiians die from diabetes at a rate that is 222 percent higher than for the U.S. all races (S87, The Native Hawaiian Health Improvement Act)

Project Objectives

- Improve Diabetes care for the people in Hana through using the chronic disease model and rapid change model (Institute of health)
- Use telemedicine and a web based application to improve access to specialty care and self-management support.
- Develop a model that is effective, efficient and exportable to other rural communities.

Experience/Resource to the Community

Dr. Joe Humphry

- Primary Care Internist with special interest in Diabetes
- 19 years- CHC experience
- 3 years-Disparities Collaborative (BPHC) (2 CHCs)
- American Asian/Pacific Island Work Group Member (NDEP)
- Advisory Council-Pacific Diabetes Today Resource Center
- Previous Project Coordinator for Staged Diabetes Management in Hawaii (International Diabetes Center, MN)
- Clinical PI-Ohana Health Project (Dept of Electrical Engineering, University of Hawaii)
- Medical Director-HMSA (Guideline development, HEDIS, NCQA, Disease Management)

Hana Community Health Center

- The Health Center is the only available care provider in the Hana community
- The Health Center provides physician services 24/7 (Currently Locums)
- Professional Staff- Part time nurse
- Rest of the staff are local hires with limited health experience and OJT

Rural Health Care

Diabetes Team

Core Team-NDEP

- Primary Care Provider
- Nurse
- Dietitian
- Endocrinologist/Diabetologist

HCHC Diabetes Team

- All employees at the health center
- Dr. Humphry (every other Thursday+telemedicine)
- Ophthalmologist 1 day per month
- No PCP or full-time nurse
- No Pharmacy
- No laboratory on site (Blood draws only)

Hana Diabetes Program

- Just do it! December 7^{th}, 2000
- Video-conferencing- December 14^{th} ,2000, Patient follow-up and team building
- 2 Saturday “learning sessions” with staff to dates
- Implementing change/rapid change model-sort of

Demographics

	M	F
Sex	42%	58%

Age Distribution

		N	Percent
45-54		5	21%
55-64		6	25%
65-74		9	38%
75-84		4	17%

Results

	Frequecy	Hana N=24	ADA Rec	HI Hedis 2001
HbA1c	1 time/yr	100%	93%	79%
Proportion w/HbA1c < 8%	(most recent test)	83%	55%	
Proportion w/HbA1c > 9.5%	(most recent test)	0	≤ 21%	51%*
Eye exam	1 time/yr*	54%	61%	56%
Foot exam	1 time/yr	71%	80%	
Blood pressure frequency	1 time/yr	100%	97%	
Proportion < 140/90 mm Hg	(most recent test)	75%	65%	
Nephropathy assessment	1 time/yr	100%	73%	53%
Lipid profile	1 time/yr	96%	85%	82%
Proportion w/LDL < 130 mg/dl	(most recent test)	75%	63%	49%

Additional Results

Measures	Hana N=24
2 A1c in year	83%
ACE	83%
Statin	67%
ASA	88%
Flu	58%
Pneu	83%

A1C Changes

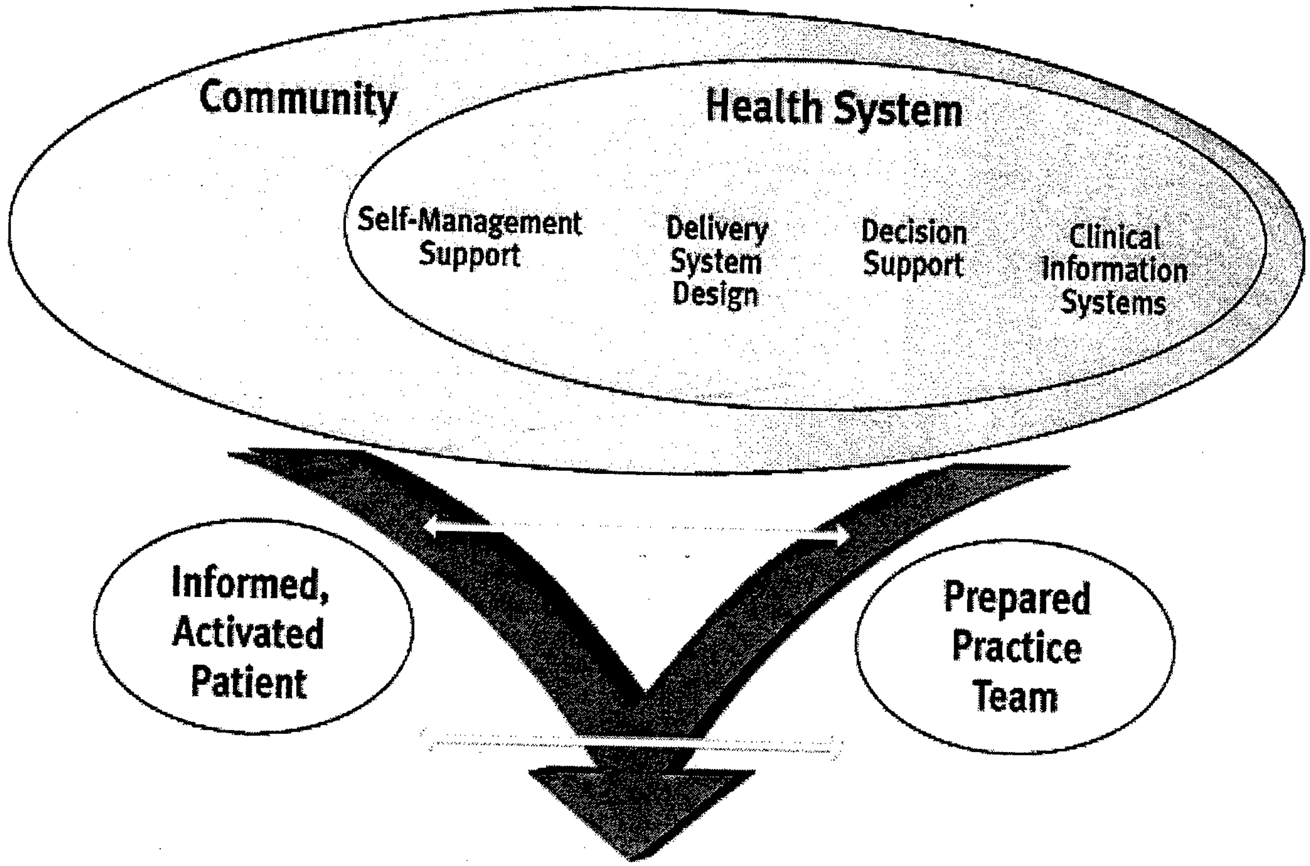
High to Recent

[redacted]

11.10	→	6.90
11.00	→	7.70
10.40	→	7.40
6.90	→	6.50
7.60	→	6.80
7.70	→	6.90
8.40	→	6.80
7.30	→	6.90
10.30	→	6.40
7.40	→	6.90
6.20	→	6.00
8.20	→	7.60
8.30	→	7.10
10.20	→	8.30
7.80	→	8.40
6.10	→	6.10
8.80	→	7.50
11.50	→	7.90
10.80	→	9.10
9.70	→	7.80
8.80	→	7.70
11.60	→	7.20
8.50	→	8.20
9.00	→	7.00

[redacted]

Chronic Care Model



Hana
Keys to Success

- No fast food
- Strong sense of community and Hawaiian tradition
- A well structure medical record system
- Community involvement/community outreach

System Design

- Implement diabetes flow sheet borrowed from the Community Clinic of Maui (DM Collaborative)
- Multiple staff are now trained to use the Ultra meter and checking blood glucose is part of the check-in process
- The staff is trained in foot exams and we are setting up foot screening and patient foot education run by the staff (NDEP and LEAP programs)

System Design

- Telemedicine to improve access, provide timely follow-up and build relationship with the health center.
- Telemedicine is part of the change model and not a separate project

Decision Support

- Aggressive treatment to goal/ medication dose escalation and multiple insulin starts
- Staff education on standards of care/ DM flow sheet

HCHC/Community Resources

(Social Capital)

- Exercise:11 one hour classes from very low to high impact exercise 4 days a week
- Meal: Provide Health Lunch (Traditional Hawaiian Food) to Seniors 60 and over
- Home delivered meals: Hot lunch and dinner are home delivered with a medical referral
- Knowledge: Staff is trained in basic nutrition (including reading food labels, fitness, living with diabetes, glucometers, and foot exams
- Kulia Ola Kimo Maikai-Diabetes Education program taught by peer educators

Self-management

- Over 30 One Touch Ultra Meters supplied by Life Scan have been provided to patients
- Know your numbers/Self management patient information sheet including ABC goals and current lab results

Telemedicine/Lessons learned

- Most telemedicine demonstration projects have not been sustainable
- Telemedicine is used to support the chronic disease model and improve access
- Single source of compensation is a more rational approach to payment
- Telemedicine increases cost and needs to improve the quality of care to be financially viable

Moving Forward

- Improving access/improving care-alternative approaches to patients not yet in the program
- Ohana Health- web based self-management and diabetes registry-remote monitoring/improved access
- Screening and case finding

Ohana Health Online

www.the-ohanahealth.org

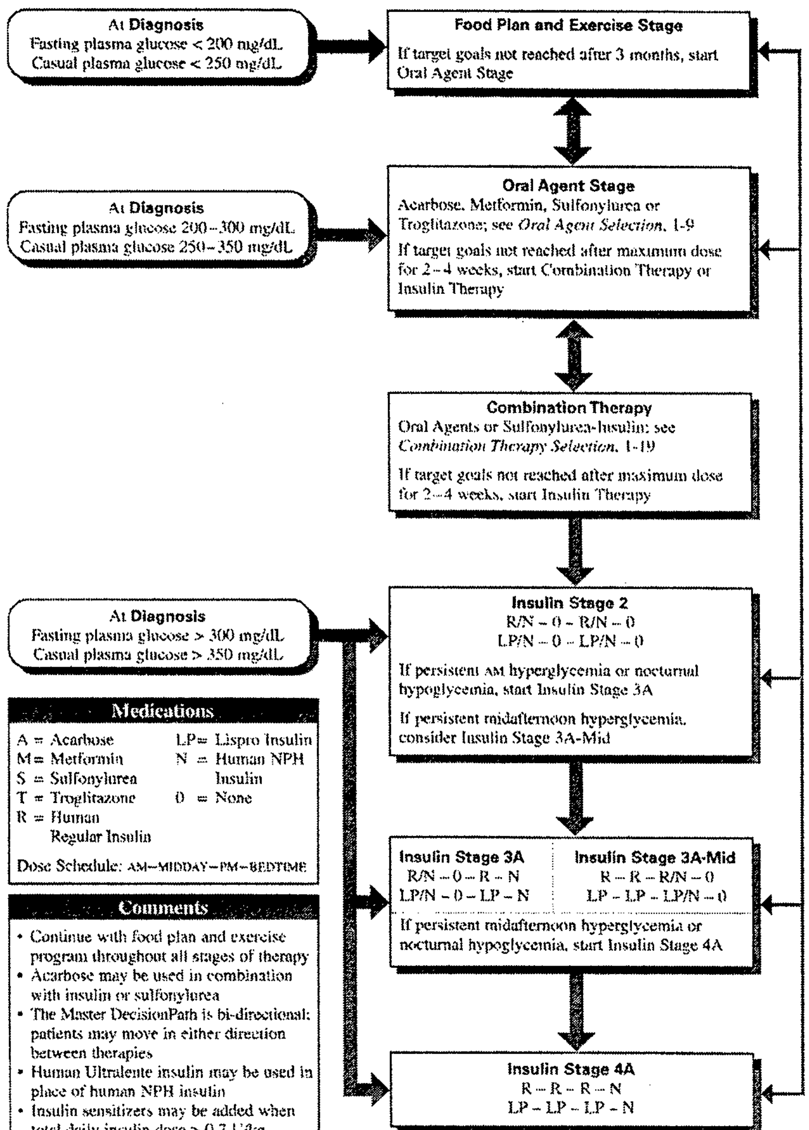
- Developed by Dr. David Yun, Professor of Computer Science in the Department of Electrical Engineering, University of Hawaii.
- Professor in software architecture and application design.

Ohana Health Online

www.the-ohanahealth.org

- **Self-management support**-patient record, Self-management goal setting
- **Information system:** Patient encounter form, population-based reporting, Glucose meter upload and automatic lab data retrieval
- **Decision support:** Stage Diabetes Management decision trees:Patient/Doctor alerts
- **Delivery system design:** Web based report generation part of office visit check in, health center web access, Messaging, remote access to health information

Type 2: Master DecisionPath



Medications

A = Acarbose	LP = Lispro Insulin
M = Metformin	N = Human NPH Insulin
S = Sulfonylurea	0 = None
T = Troglitazone	
R = Human Regular Insulin	

Dose Schedule: AM–MIDDAY–PM–BEDTIME

Comments

- Continue with food plan and exercise program throughout all stages of therapy
- Acarbose may be used in combination with insulin or sulfonylurea
- The Master DecisionPath is bi-directional: patients may move in either direction between therapies
- Human Ultralente insulin may be used in place of human NPH insulin
- Insulin sensitizers may be added when total daily insulin dose > 0.7 U/kg

Type 2: Metformin/Start

At Diagnosis
Fasting plasma glucose 200–300 mg/dL
Casual plasma glucose 250–350 mg/dL
Obesity (BMI > 27 kg/m²)
Mild or no symptoms

OR

From **Food Plan and Exercise Stage** or another **Oral Agent Stage**
Patient has not reached targets after 3 months

History, physical exam, and laboratory evaluation by clinician

See *Medical Visit*, 4-1

SMBG Targets
- More than 50% of values within target range
- Pre-meal: 80–140 mg/dL
- Post-meal (2 hours after start of meal): < 160 mg/dL
- Bedtime: 100–160 mg/dL
- No severe (assisted) or nocturnal hypoglycemia

Adjust target upward if frail elderly, decreased life expectancy, cognitive disorders, or other medical concerns

HbA_{1c} Target
- Within 1.5 percentage points of upper limit of normal

SMBG Frequency
- Test 2–4 times/day; before and 2 hours after start of meals and at bedtime

Start Metformin

Assess food plan and exercise
See *Food Plan and Exercise*, 1-7

Dose (take in the PM)
Metformin: 500 or 850 mg/day

Refer patient for nutrition and diabetes education
See *Nutrition Education*, 4-19, and *Diabetes Education*, 4-11

Precautions and Contraindications
- Pregnancy and lactation
- Risk of lactic acidosis in patients with:
  - Renal disease (serum creatinine > 1.4 mg/dL)
  - Liver dysfunction
  - Alcohol abuse, binge drinking
  - Acute or chronic metabolic acidosis
  - Acute cardiovascular or pulmonary disease
  - In patients > 80 years old unless creatinine clearance demonstrates renal function not impaired
  - Patients with CHF who require pharmacologic treatment
- Stop Metformin at the time of, or prior to, intravenous radiographic contrast procedures; restart therapy in 48 hours when renal function found to be normal

Side Effects
- Usually dose related and self-limited
- Common: Diarrhea, nausea, and abdominal discomfort
- Occasional: Metallic taste

Follow-up
Medical: Within 1 week

Move to **Metformin/Adjust**, 1-14

Encounter Form(DEMS)

www.the-ohanahealth.org

Ohana Health Patient Encounter Report

Click Here to Add Info

	Last visit		This Visit		
Date	3/1/02				
Weight	224				
pulse	80				
BMI	34				
Office BS	127	cpg		CPG/FPG:	
BP-Sys/Dia	112 /78				
MEDICATIONS	Dose	sig	MEDICATIONS	Dose	sig
Pioglitazone	15	qd			
Prandin	15	tid			
Problem List	Date		Problem List	Date	
Cirrhosis	1/1/02				
Health Profile			Health Profile		
Self monitors BG	Yes		Self monitors BG		
Exercise x/wk	1		Exercise x/wk		
Smoker (Nev/Pas/Cur)	Pas		Smoker (Nev/Pas/Cur)		
Self goal			Self goal		

REFER/EDUC	Last Visit		This Visit	
	Date	Ref	Date	Ref
DM Educ	7/1/01	R		
NutEduc	7/1/01	D		
Retinal Ex	7/1/01	D		
Smke Ce				
Pne Vac				
Flu Vac				
Dental				
SM Goal				
Foot chk	7/1/01	R		
Foot Risk(0-3)	7/1/01	1		

Diabetes Encounter Record		ID:
Smith , John	Male	46
1/1/56	Hawaiian	Language:
Height:68	Type:2	Stage:Oral Agent
Date of Diagnosis:		Phase.3

Note:

Patient Note:

The predeterminated next visit date:2/2/02

New Note:

Next visit Date:

LAB TESTS	Last Visit		This Visit	
	Date	value	Date	value
HbA1c	4/19/02	6.8		
MiAlCr				
Creat				
SGPT				
Chol				
Triglyc				
HDL				
LDL				
24hrUP				

Conclusion

- Organizing care in a rural health center based on the chronic care model improves the quality of care
- Telemedicine increases access at a reasonable cost when combined with system design changes
- Web based registry and self-management support promises to further improve care

Funding

- Principle funding is from the Hana Community Health Center for the physician's clinical time and telemedicine cost
- Support is provided from the University of Hawaii Telemedicine Program/QMC
- Support from the Web-based Ohana Health Project- University of Hawaii Department of Electrical Engineering, ***<u>Lab of Intelligent and Parallel Systems (LIPS),</u>***

hana Health Online System

Providing Services in Remote Health Management

Patient-centered web-based medical record with patient access to all relevant clinical information for their diabetes care.

Online support of registration, reports, demonstrations and help.

Patients can easily ***upload*** home-monitoring ***glucose data***.

Automated ***lab data uploads*** from both local testing labs.

Every ***clinical*** visit information and doctor-patient interaction, including measurements, diagnosis, treatment, medication, diet and goal setting, are summarized in an "***encounter report***".

Timely tracking of all relevant, individualized data; ***instant data analysis*** for generating reports and messages/alerts to assist both patients and doctors in ***self-management/care of diabetes***.

Interactive self-management goal setting for patients to communicate health goals to the provider on the encounter form.

Multiple level ***HIPPA security compliance*** with patients able to view their records, physicians able to view all their patient records and clinics able to view all clinic records and treatment outcomes.

Population-based reporting of process and outcome measures for physicians and clinics.

Secure messaging system that facilitates communication among all participants, patients, doctors, nurses, clinics, labs and computers

Staged Diabetes Management (of IDC) serves as an intelligent expert system that follows the clinical course of individual patients according to the "***best-practice***" decision protocols, and ***issue alerts***

Extension of services beyond the wired WWW, to include ***wireless devices, PDAs and cell phones***.

System is designed for ***scalability*** and coverage of ***other illnesses***.

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